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BACKACHE: COMMON CAUSES AND TREATMENT WITH SPECIAL REFERENCE TO PHYSICAL THERAPY*

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The medical and surgical terrain of backache is far too extensive to be considered comprehensively within the scope of any one paper. It is not our intention, therefore, to consider every facet of this many-sided problem, but we shall discuss the causes and treatment of the more common and important forms of backache with which we have daily personal experience.

While it cannot be assumed that lower vertebrates are immune to all the aches and pains which are the common lot of man, we must admit that the assumption of the erect attitude by man has potentially increased the stresses and strains with which his vertebral column has to contend. In no section of his spine are these effects more pronouncedly active than in the region of the sacroiliac and lumbosacral junction. With only too good reason must low back pain be considered as one of the most common disabling conditions to which flesh is heir. Its cause is legion.

With the causal factors as numerous as they are varied, it is to be expected that treatment will be correspondingly diverse; for just as there is no set cause of backache, so there is no set cure. By careful diagnosis and appropriate selection of physical therapeutic measures, supportive corsets and wise surgical treatment, we can provide relief to a large number of patients and even assure cure in certain cases.

Consideration of the therapeutic measures advocated for the treatment of backache resolves itself into a dual problem; we must consider the chronic as well as the acute conditions which provoke this major complaint. Success in dealing with these cases comes only with experience and understanding co-operation of physical therapist, roentgenologist and surgeon. In assessing disability and advocating the appropriate remedial measures, the personal equation of patient and internist must be considered. Much time is wasted and prestige lost by failure to assess correctly the psychologic characteristics of the patient and their bearing on the subjective complaints.

Since many of the exciting factors are imperfectly understood, classification of the forms of backache is difficult, but as knowledge is increased by pathologic and surgical research and specific etiologic factors are isolated, as in the case of protrusion of intervertebral disks, or spondylolisthesis, a more simple and accurate grouping will be possible.

Backache Due to Arthritis

Generally speaking, conservative measures should receive first consideration since many, one might almost say the majority, of backaches will respond satisfactorily to the simpler methods of treatment and, even if these fail to relieve completely, they very frequently provide a clue as to what

* Read at the Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 6, 1939.

should be done subsequently. To urge surgical fusion of a lumbosacral and sacroiliac joint, the seat of hypertrophic changes or well marked arthritis, when no relief has followed the use of a well fitting lumbosacral or sacroiliac belt, may court an unsatisfactory postoperative result. Again, the absence of any alleviation of the patient's symptoms by routine use of rest and physical therapeutic measures may be the deciding factor in instituting extensive neurologic investigation in an obscure case of backache with sciatica. It will be found that the condition in a vast majority of patients with sacroiliac arthritis will improve with the use of heat, massage, supportive corsets and change to a less strenuous life (fig. 1). Heavy lifting should be avoided. The actual disease may run a course of several years during which, if treatment is carried out faithfully, there will be steady diminution in the subjective symptoms until with fusion of the joints by nature, cure occurs. Only the very vigorous, who are subjected to repeated strain and to whom rest is impossible, should be considered for surgical fusion.

The perennial question regarding the influence of focal infection in backache and joint pain cannot be answered in a word. The removal of infected teeth, or tonsils, or treatment of prostatitis will not alter the architectural changes which have been occasioned by time, trauma or infection, but all of us have experienced the dramatic improvement which has occurred in some painful joints following removal of an abscessed tooth. While we can guarantee nothing, we believe that all grossly visible foci of infection should be removed on general principles in all cases in which severe discomfort and pain occur in the osteoarthritic and hypertrophic spines of middle-aged but otherwise healthy men, if complete relief has not followed the use of heat, massage and supportive belts.

It is in the treatment of acute backache that physical therapy produces its most spectacular results. The acutely painful back which is so characteristic a precursor of influenza or smallpox, or follows unaccustomed and prolonged physical effort, such as gardening, forms an excellent example of the efficacy of heat and massage in the cure of low back pain. Fibrositis, myalgia and "facet syndrome" pain all can be grouped together as etiologic factors in acute backache, and each is susceptible of considerable relief by physical therapeutic measures.

For cases in which structural defects and obvious pathologic change are absent, our routine treatment is standardized and successful within a few days. The patients are hospitalized in a bed provided with a lumbar sling and apparatus to apply extension to the lower limbs in the manner shown in figure 2. To begin with, 4 to 6 pounds (1.8 to 2.7 kg.) are applied to each lower limb and the patient lies on the lumbar sling in such a manner that the buttocks and lower part of the lumbar spine lie on the canvas support. The weights are increased from time to time if this is found to be necessary. The discomfort is increased, usually, by the hyperextension of the spine and by the unaccustomed pull on the legs; few patients can tolerate this position more than an hour or so at a time during the first one or two days. It is our custom, therefore, to release the weights or allow the patient to be out of the sling at stated intervals and at meal time. Codeine may be necessary for sedation, but after the first few days' administration of this drug, it can be discontinued as most patients are then able to lie in their slings for hours on end.

Daily or diurnal applications of heat are given either by the near infra-red rays, since they are more penetrating than the nonluminous sources of heat, or by means of the fever cabinet or Hubbard tank. Diathermy is used occasionally and may be alternated with sessions of other treatment. Choice of sedative or stimulating massage depends on the type of each case. If it is one of fibrositis, deep kneading to dissipate the fibrous nodules is an essential part of the treatment. The large proportion of patients will respond within a week, with diminu-

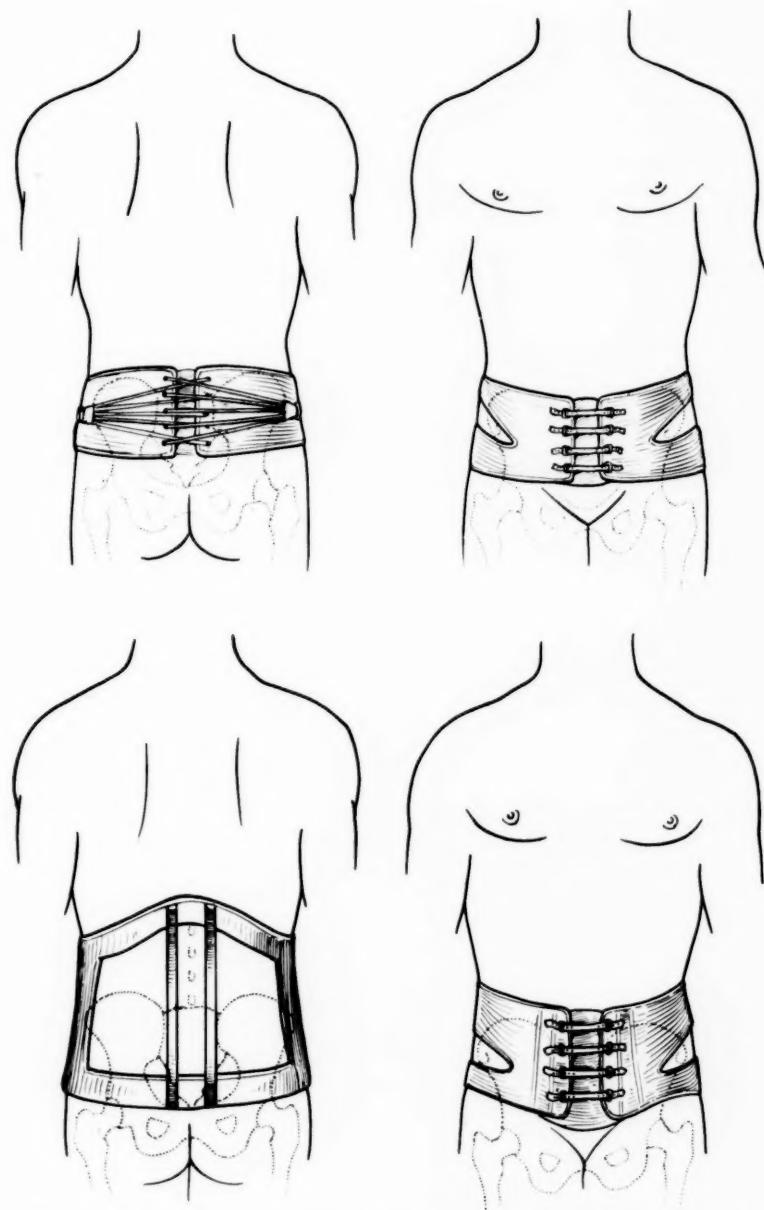


Fig. 1. — Left two figures, Sacro-iliac belt used in the treatment of sacro-iliac strain or arthritis of the sacro-iliac joint; right two figures, chair-back brace used in backache and conservative treatment of spondylolisthesis.

tion of pain, loss of muscular spasm and disappearance of contractual deformity, and most of them can be dismissed as cured by the tenth day. Manipulative maneuvers through an extended normal range are prescribed for those patients who do not respond to the treatment just described. General anesthesia by pentothal sodium, given intravenously, is used and kneading of muscles may aid in reducing spasm during the manipulation. Subsequent fixation by a hyperextension plaster of Paris cast for two or three weeks, controls the pain of most of those patients who have proved resistant to the preceding regimen. Many of these cases of acute backache are related in their onset to trauma or overstrain of muscles and ligaments but, in addition to this, one must remember

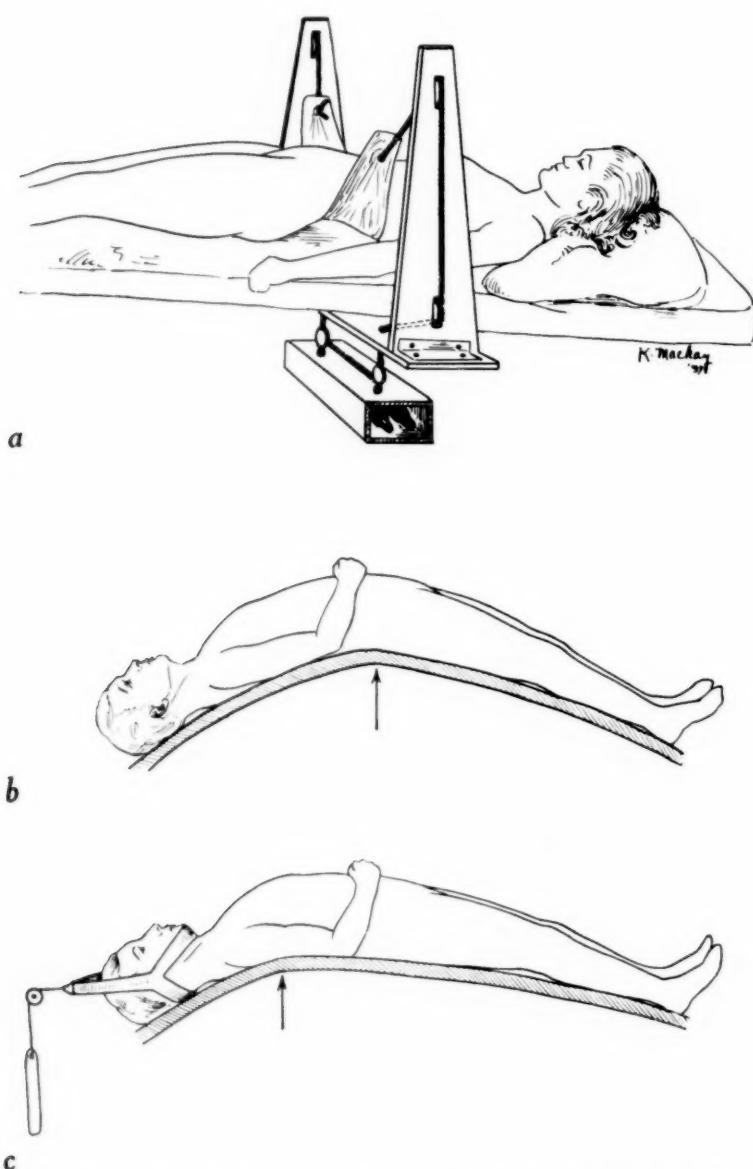


Fig. 2. — *a*, Lumbar sling used in the treatment of backache; *b*, hyperextension frame used to correct compression fractures of vertebral column; *c*, hyperextension frame with head traction used in correction of kyphosis resulting from spondylitis, tuberculosis or fracture.

that not a few are complicated by underlying psychic factors, in which instance ordinary methods of treatment have little effect until this latent cause is dissipated by wise or understanding counsel.

Complaint of backache by a young married woman may, on analysis, be found to spring from sexual incompatibility or from fear of pregnancy. In these cases, the symptom is a defense mechanism, built up either consciously or unconsciously, but until its psychologic background is fully discussed and explained, physical therapeutic measures will be largely ineffective. These patients are not malingerers, but constitutionally inadequate persons who shrink from responsibility by hiding behind the bulwark of a functional complaint. In the more chronic forms of backache classified under spondylitis or chronic arthritis,

acute exacerbations may occur from time to time. In the care of patients with these conditions, much relief can be obtained during the acute phase by the methods already discussed, but provision must also be made for more prolonged or amplified "after treatment." Heat, traction and massage are always followed by considerable relief, but in addition to these measures, the use of arthrotropic vaccines, supportive corsets and corrective braces tend to counteract the underlying infectious process, relieve muscular spasm and prevent increasing deformity.

Backache Due to Specific Pathologic Processes

Elderly patients suffering from spondylitis or osteoporosis tolerate only reluctantly any form of spinal brace. Yet it is imperative, especially in the latter condition, that some form of support be worn to guard against the occurrence of pathologic fracture, which is a common complication of this latter disease. A high, reinforced corset, with shoulder straps, is not too cumbersome and will be worn usually without excessive complaint (fig. 3). The use of ultra-

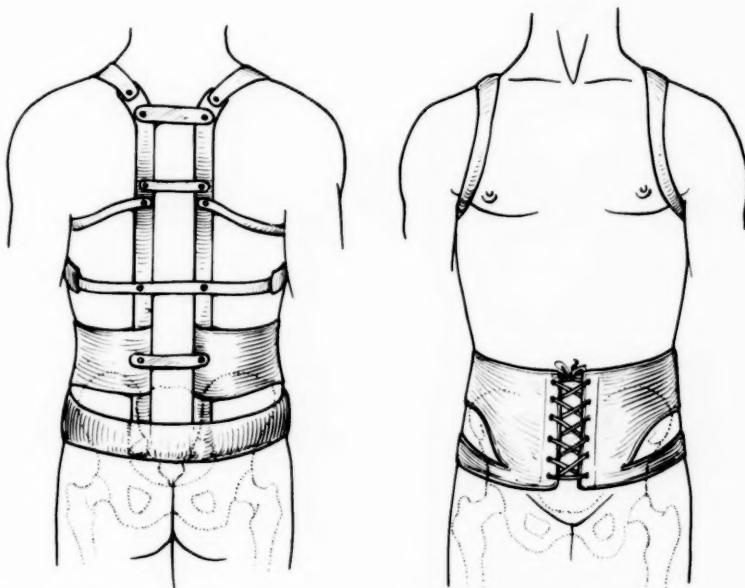


Fig. 3. — Taylor brace used as a supportive and immobilizing agent in the treatment of diseases of the vertebral column.

violet rays, cod liver oil and calcium in osteoporosis, while unproductive of any appreciable roentgenologic improvement even after a year or more, is followed by clinical benefit. In these cases also we are trying the effects of theelin, since patients with osteoporosis so frequently are elderly women who have passed the menopause, but so far we have not had a sufficiently large number, and the investigation which is being carried out is not far enough advanced to justify a dogmatic opinion.

In fractures of the body of the vertebrae or their processes, maximal relief is obtained by prolonged rest, while restitution to normal anatomic contours usually follows hyperextension of the spine, with traction and countertraction. Body casts may be applied or the patient may be nursed on a half cast which causes hyperextension of the back. The benefit of the bivalved cast lies in the fact that heat and gentle sedative massage can be applied routinely, whereby muscular relaxation is brought about and a more nearly perfect return to the anatomic norm may be obtained. Loose fragments from the tips of the spines

or transverse processes, or even of the articular facets, can be removed surgically in well chosen cases with a more rapid return to full functional activity. For some reason the pain lasts for a shorter period and there are not the same number of chronic sequelae among patients who are treated in this fashion.

In acute specific infectious diseases of the spine, treatment is directed against the causal agent by administration of vaccines, eradication of foci and by physical therapy and dietetic measures calculated to raise the resistance of the host to the invading organism. Vaccines may be specific or polyvalent, although in many cases satisfactory results have followed the use of the nonspecific methods of inducing protein shock, by milk or typhoid vaccine. Fractional or prolonged sessions of fever therapy have almost revolutionized the treatment of gonococcal infections, particularly when the use of sulfanilamide is combined with this form of attack. In spondylitis also gratifying improvement, with relief of pain, has followed the combined attack by fever therapy and sulfanilamide.

Brucellosis has been regarded as one of those diseases for which the Pharmacopeia held little that was helpful. Treatment along general supportive lines, and firm conviction of the efficacy of *vis medicatrix naturae* were the alpha and omega in therapy. Recently, however, pronounced successes have resulted from artificial fever treatment. Temperature charts recording prolonged and continued high temperatures have shown the early response provoked by fever therapy and after a few treatments in many of the cases the temperature has become normal and has remained so. In addition, the patients have subjectively and objectively improved.

Active treatment of acute inflammatory conditions usually is limited, in so far as surgical treatment is concerned, to the evacuation of pus or removal of sequestra which are causing pressure symptoms on the cord or nerve roots, or by their presence are maintaining a sinus tract in a state of constant or intermittent activity. With the introduction of sulfanilamide and sulfapyridine, alone or combined with fever therapy, a new era in the treatment of this distressing and serious disease may have dawned.

Actinomycosis, although not common, is nevertheless a serious infection for which little could previously be done beyond administration of potassium iodide to the point of maximal tolerance. Recently, however, successful results from the use of roentgen therapy have been reported. As an adjuvant to healing and a source of relief from pain, ultraviolet light and luminous infra-red therapy are recommended.

In many cases of infection, however, active attack on the region of disease is impossible. This is particularly so in acute febrile conditions, with severe backache, without roentgenologic evidence of spinal involvement in the early stages. Later, roentgenograms may give evidence of rarefaction of the contiguous margins of two adjacent vertebrae. If the course of the case is followed by repeated exposures to roentgen rays, relief is seen to occur after some months with the production of hypertrophic spurs and ultimate fusion. In these as well as in cases of typhoid spine in which the process was not susceptible to treatment by heat, immobilization in plaster casts was all that one could do previously. Now, with fever therapy and chemotherapy the outlook may be brighter and the course less severe and prolonged.

Active surgical treatment for benign neoplasms of the vertebral body may, under certain circumstances, be feasible, but the difficulties of approach and the liability to severe hemorrhages render conservative measures the more acceptable form of therapy. Diathermy and exposure to infra-red rays give temporary relief to the ache of which certain of these patients complain, but the giant-cell tumors and hemangiomas of the body respond so well to roentgen treatment that this is now the generally accepted method of dealing with them. A pathologic fracture is not an infrequent complication in many of these cases and, when this

occurs, the use of a cast or brace, or even the more permanent method of fixation by a bone grafting operation may be indicated.

Surgical attack on primary malignant neoplasms of the spine has not been an unqualified success, and similar methods directed against malignant metastases are foredoomed to failure. If patients are affected by these conditions, roentgen rays, radium and physical therapeutic measures fulfill a useful role in prolonging life and relieving pain and, in so far as they render the lot of the one so affected more comfortable, they are justifiable procedures, even in the terminal stages of metastatic involvement.

Congenital Anomalies and Other Factors

Congenital lesions *per se* should not be the cause of pain or discomfort, and it is our conviction that only in rare instances are they other than developmental curiosities. We do not deny the view, however, that they may render the individual so affected more susceptible to injury. About 10 per cent of cases of congenital spondylolisthesis are asymptomatic and are encountered accidentally during a routine examination. However, about 85 to 90 per cent of patients with spondylolisthesis have as their principal complaint, low backache and some are so disabled that surgical fusion is necessary. Of those who do complain, a large number owe the onset of symptoms to intercurrent injury. Physical therapeutic measures will not alter the architectural conformation of the spine, but heat, massage and a chairback brace, by relieving muscular and ligamentous strain, will enable most patients who have not been subjected to surgical operation to lead a fairly active and productive existence.

Incomplete sacralization of one or both of the transverse processes of the last lumbar vertebra may become the seat of traumatic arthritis as the result of multiple microtraumatism. With arthritic changes well developed, these regions become the points of origin of painful afferent stimuli if affected persons are called on to perform heavy labor. A completely sacralized process will not cause pain, although it may predispose to the development of lumbar scoliosis. Alteration of the alignment of the lower lumbar articulating facets may contribute to the onset of low back pain.

In these cases also, improvement follows the use of heat, sedative massage and adequate immobilization. Congenital shortness of one leg, or the presence of wedge-shaped vertebrae, by altering the alignment of the segments of the spine, produces fresh strains and stresses as a sequel and structural alterations as a late result, each of which adds its quota in the shape of discomfort and pain. In most of these cases a modicum of relief will follow standardized physical therapeutic measures, postural training and the wearing of spinal supports. In a few of the cases which progress, elevation of the heel of the shoe on the side of the shorter leg, or even surgical fusion, may be required.

Extraspinal causes of backache embrace a multiplicity of factors, many of which are of frequent occurrence, but not a few of which are only of academic interest. As an initial step in the control of this group, removal of the primary cause or correction of the predisposing factor, if this is possible, is indicated. An incarcerated, retroverted uterus is replaced, a perinephritic abscess evacuated, or a retroperitoneal tumor removed.

The backache which occurs as the result of overstretching of muscles and relaxation of ligaments in the course of long anesthesia, and which renders the immediate postoperative course a miserable experience, responds within a few days to applications of heat followed by sedative massage. A firmly applied binder, adhesive strapping, or a lumbar sling are of great assistance in relieving this type of discomfort.

Intraspinal lesions are not amenable to conservative measures, although temporary relief may follow physical therapeutic treatment in some instances. As a

rule, however, the lack of response to physical therapy in cases in which backache occurs in the absence of gross roentgenologic alterations in the spine is an indication for further investigation, including a neurologic survey. The history of an accident followed by backache and immediately, or at a later date, associated with sciatica, should suggest protrusion of an intervertebral disk as a likely diagnosis. If, in addition to this, the patient states that he has periods of freedom from pain but, when his pain is present, sleep is hindered and coughing or sneezing accentuates his discomfort, we have an almost classic story which is confirmed by the discovery of diminution or absence of the Achilles or quadriceps reflex. When these findings coexist, spinal puncture, with examination of the cerebrospinal fluid, with injection of air or radiopaque oil and subsequent roentgenologic examination is indicated as a prelude to laminectomy. When intraspinal tumors are the cause of backache, trauma is not necessarily a preceding event nor is the root pain frequently unilateral. As a rule, with tumor the findings are more slowly progressive, while intermissions are infrequent. Sphincteric disorders are common in cases of this type. When the level of the defects in the air or shadows made by use of radiopaque oil corresponds to the clinical interpretation of the symptoms, laminectomy is indicated.

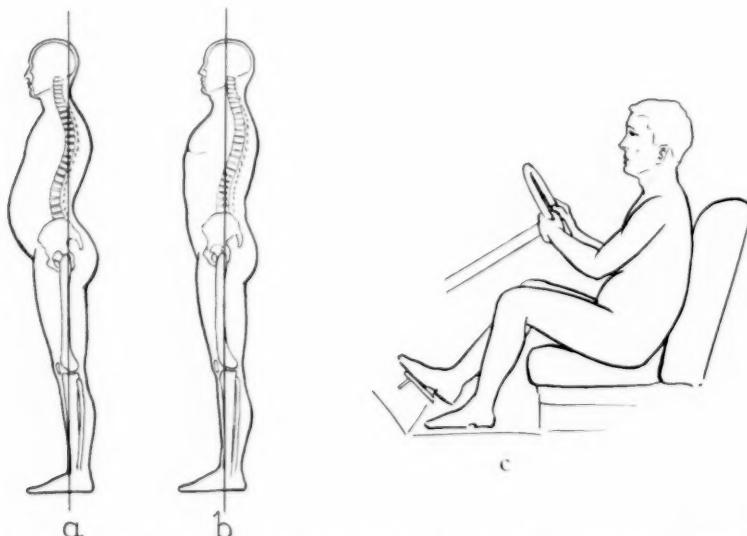


Fig. 4. — *a*, Poor posture with loss of muscle tone; *b*, posture corrected by exercises consisting of voluntary muscular contraction; *c*, poor posture assumed in automobile seat, as a cause of backache.

Not a few of the backaches in youth, as well as those which develop in more advanced years, owe their origin to faults in posture. Muscular weakness or imbalance, or habits acquired from occupational activities or physiologic necessity, such as long hours of sitting at desks of poor design or attitudes necessitated by visual handicaps, will cause backache. When these factors continue to act over a long period, they may ultimately lead to structural alterations. Thus, although originally purely functional and capable of voluntary correction, the latter state of the patients may be one of irremediable deformity (fig. 4).

In this postural form of backache with scoliosis, the physical therapeutists have a field of endeavor the cultivation of which will yield a harvest rich in arrested and corrected spinal deformities.

Corrective exercises to tone up relaxed or overstretched muscle fibers are taught to the patients; they are instructed in the maintenance of correct posture and in the importance of following their daily courses of exercises with an

almost religious zeal. Casts, braces or even surgical fusion may be necessary in advancing or advanced cases, but whether the routine be conservative or surgical, the secret of success lies in the enthusiastic co-operation of teacher and pupil, and a patient's painstaking enthusiasm in the performance of the daily exercises. Photographs and roentgenograms, taken at regular intervals, not only record the progress of improvement but aid immensely in building up the patient's courage and confidence as he marks off these milestones on the way to cure.

Psychoneurosis and Backache

The psychoneurotic group of patients is one of profound interest. To dismiss these patients as neurotic or to classify them among those of constitutionally inadequate personality, is neither fair to the patient nor is it in the spirit of Hippocrates. Undoubtedly some patients are malingerers who recover with the settlement of their compensation claims or the fulfillment of their subconscious desires, of which their backache is but the outward manifestation, but the majority are honest.

Most of us willingly admit that the presence of a congenital defect in the osseous skeleton predisposes that individual to backache from subsequent trauma, but are we as lenient with those whose complaints are of those conditions which, for want of a better name, we term functional? Might there not be congenitally weak links in the gossamer elements of which the central nervous system is built up? If we admit that a developmental defect in bone may predispose to the occurrence of pain following even slight trauma, should we not be equally ready to extend similar credence to those whose pains are mostly "in their heads"?

The nervous, anxious woman with a painful coccyx may obtain, in our experience, only a temporary respite from pain by surgical methods. The majority, if they receive daily Sitz baths, encouragement, diathermy and massage of the coccygeus muscles, will obtain relief from symptoms.

Discussion

Dr. F. H. Ewerhardt (St. Louis): It should be noted that the essayists make no pretense of covering the entire subject of disabilities of the lower back, but only touch on some of the important forms with which the general practitioner has common experience. Structurally, the lower back may well be regarded as the weak link in the entire skeletal chain. This is so because of the relatively unstable bony construction, the unusual stress and strain to which it is subjected, and also, I may add, the ease with which the proper functioning of a complex neuro-muscular mechanism can be disturbed and not so easily re-adjusted. This latter phase is well appreciated by those whose lot is to treat numbers of chronic backaches.

From the many known causes of backache, the authors have chosen to discuss but a few. Of those I shall discuss two or three.

In the treatment of chronic backache the conservative method is recommended as based on well-known physical therapy measures, because of the generally favorable reaction following it. Should the conservative method fail, it nevertheless provides the physician an opportunity for further and more intensive study, leading possibly to surgical fusion.

On the question of focal infection as an etiological factor, the authors wisely remain conservative. Most of us have, as

they have had, experiences of dramatic improvement following the removal of the so-called foci of infection, but have also been many times disappointed when the reaction was not so favorable.

It is easy for me to agree that physical therapy methods produce their most impressive results in acute backache. We are reminded of this symptom following unaccustomed or prolonged physical effort. Also that fibrositis, myalgia, sacroiliac strain and the facet-syndrome, may all be grouped as causative factors. However, we fail to note an expression, either pro or con, regarding manipulation in definitely established selected cases. It is my belief that this deserves a greater and unprejudiced consideration and study by the medical profession than it has thus far received. Why manipulation of the lower back should so often, either thoughtlessly or deliberately, be relegated to the cults, is a strange commentary on the medical profession. It is not only poor business but confesses a lack of knowledge of the structure and function of the tissues of the lower back, but which allegedly but certainly not factually is possessed by the osteopath. I report I am discussing manipulation of selective cases only.

In speaking of backache due to fractures, the authors rightly recommend rest with proper splinting, and yet I cannot help but sound a warning of the danger

of creating a new and perhaps far more lasting disability than the fracture itself. I am referring to a cruel psychologic mistreatment of the patient and thereby creating a traumatic neurosis much more difficult to cure than the initial injury. For example, a simple lineal fracture of the body of the vertebrae without displacement, hemorrhage, or central nervous disturbance, and perfectly understandable by the surgeon, may lead to difficulty if the term "broken back" is used in the presence of the patient. In this case I believe that early functional treatment with proper physical measures consistent with maintaining proper alignment and position is especially imperative.

I can well agree with what the authors say on congenital anomalies. It does seem plausible to assume that such a back may well be regarded as a potential weak back, more easily susceptible to injury than a normal one, and therefore predisposed to traumatic arthritis. But until a trauma has actually happened, the anomaly itself is usually not regarded as a cause of backache. The authors rightly conclude that in these conditions physical therapy may be of considerable help in making the patient more comfortable and allowing him to lead a fairly active life.

Dr. Louis Feldman (Boston): What I have to say is not so much a matter of discussion but to ask a question about the omission of some very useful procedures we use in Boston Forest Hills General Hospital, especially in my connection with the Boston State Hospital Physical Therapy Departments. In the latter we have as many as two thousand mental patients who also have these various general medical, surgical and orthopedic conditions. I have not heard the authors mention the use of caudal or perineural injections in sciatica, and I have not heard the authors speak of fasciotomy according to Dr. Ober in the tightening of the tensor fasciae femoris that we quite frequently find in these patients with the lower back strains and pains of long duration. I would like their opinion on that point.

Dr. Otto Steinborker (New York): Dr. Meyerding has well covered a wide field in a short time. Some of the points brought up in the discussions suggest that I mention our experience with the treatment of backache at the Post-Graduate and the Bellevue Hospital Arthritis Clinics which might be of interest. Although one is not inclined to discuss measures other than physical therapy at this Congress, it may be appropriate to mention that there are at present a number of additional procedures developing which offer much hope for the alleviation of backache when used in conjunction with a physical therapy routine.

Excepting a small number of patients who present at once or after study a distinct orthopedic problem, it seems from our experience that backache is essentially a medical condition, or, we might better

say, a non-surgical condition, especially when we consider the figures published by many large centers; for example, those which have emanated from the Mayo Clinic, where less than ten per cent of backaches are true surgical problems. These facts make us believe that for a long time the attitude toward the management of backache by medical men has been one of undue timidity. Because a small percentage of patients with chronic backache finally require surgery, there has been a tendency to be over-cautious about the systematic application of medical treatment in these conditions.

Our own results in the past few years have confirmed the impression that the greater proportion of backaches will respond to simple, non-surgical measures. We lately have found this especially true since we have employed local and regional analgesic injections when indicated. Such treatments used in association with physical therapy, postural and other accepted medical measures have relieved 50 to 75 per cent of our intractable, long-standing cases of backache.

The epidural injection, which has received considerable attention and has shown good results in many hands, has been supplemented in our program of treatment with other technical measures — simple local injections at the site of pain, or paravertebral injections with procaine. A well-planned, varied attack on long-standing backache according to each patient's needs should prove, as it has at our clinics, that the great majority of cases respond to a combination of medical, physical and analgesic measures.

Dr. Milton G. Schmitt (Chicago): I merely want to emphasize the importance attached to congenital findings in x-ray films in these cases. In the past year I have observed a number of cases where backache was assigned to existing congenital anomalies, and these patients had other conditions causing their affection; hence the patient's improvement was delayed until the real cause was found. Therefore, we should remember that a patient may have two things wrong with him at the same time.

Another thing I wish to mention is the garment of immobilization. It has been my experience that in many cases it is advisable to have a longer garment than we saw in the slides presented, in order to help immobilize the long axis and prevent lateral and dorsal flexion which, performed, puts an added strain upon the lower back. In many cases I have found the short garment very inadequate and have obtained complete relief with a longer immobilization.

Dr. George A. Pollock (closing): In reply to the various questions, I wish to state that the paper which has just been read is only a synopsis. Consequently there are one or two points regarding therapy which have not been mentioned and which we have discussed more fully in the original paper. We are in agree-

ment with Dr. Ewerhardt that manipulative maneuvers in the treatment of backache may be carried out more frequently than is done at present, provided the type of case is carefully selected. Such treatment in cases of protrusion of an intervertebral disk may occasionally give relief, but we prefer surgical removal. In certain cases of backache local anesthesia has been used in the manner suggested by Leriche, but we have not used the method over a sufficiently long period nor in a sufficiently large number of cases to permit us to draw definite conclusions from the results obtained.

Caudal and perineural injections have been used as differential tests in cases of protrusion of an intervertebral disk. Usually when a disk is protruded, the injection of procaine hydrochloride will increase pain along the affected sciatic nerve. When this occurs, it is confirmatory evidence of protrusion of an intervertebral disk. As a method of treating backache it has not been employed routinely but we have noted a number of cases in which backache not due to protrusion of a disk was present and in which relief occurred subsequent to the use of epidural injections. We have not used injections of saline solution or procaine hydrochloride in indefinite cases of backache but have in the past injected along the sciatic nerve in those cases in which the patient had sciatica of undetermined origin.

I cannot reply dogmatically to Dr. Feldman's inquiry regarding Ober's operation as we have not had sufficient experience with this procedure to formulate any conclusions.

In reply to Dr. Steinbrock's questions regarding our approach to treatment of backache, I should like to say that we make it a habit to regard all backaches first of all as medical problems. The condition is investigated thoroughly and we carry out conservative treatment consisting of rest, application of heat, traction and massage, and the use of braces. If the findings definitely indicate the presence of a lesion that may be surgical, such as sacro-iliac arthritis, lumbosacral arthritis, spondylolisthesis, cord tumor, or protruded intervertebral disk, we then consider operative interference. Many patients are sent home to try the effects of treatment by means of heat and massage and the use of belts for a period of six months before we consider operative measures. Many of the patients with spondylolisthesis can be relieved by conservative measures. One of us (M) has reported a series of 584 cases, in which this condition was present, and of this group only 100 patients had had operations. These included, as a rule, those persons who were following active occupations. Furthermore, it was found that 10 per cent of the cases had been discovered during the course of a general examination.

TECHNICIAN EXAMINATIONS

Examinations will be held in New York City and Chicago the latter part of June, 1940. Examinations will be arranged elsewhere, if the demand is sufficient. Dates and addresses will be announced later. For further information address Registrar, American Registry of Physical Therapy Technicians, 30 North Michigan Avenue, Chicago.

CROSS-FIRING TECHNIC IN SHORT WAVE THERAPY *

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The term "cross-firing" is often loosely used in connection with physical and radiation therapy, and has come to imply that the physical agent is applied in two or more different planes to the same part of the body. The word itself suggests that the various fields, be they electrical or electromagnetic, should cross at the point where their maximum effect is desired.

Although in the case of radiation therapy one can conceive of the several applications being administered simultaneously, this is not possible where electrical fields are concerned. The advantages of applying cross-firing methods to electrotherapy have long been appreciated, and I imagine that the first attempt at making use of it originated when it was realized that the factor which limited the amount of current used in galvanism was its action on the skin. To obviate this, some authorities, in the treatment of a joint with direct current, will advocate the use of the antero-posterior, lateral and longitudinal application of electrodes in strict rotation.

With diathermy, the problem is slightly different. Here the barrier is not so much the corneal layer of the skin as the subcutaneous fat which tends to heat up and thus precludes the using of larger currents which otherwise would result in a greater rise of temperature in the deeper tissues.

Bucky designed an alternator which at first sight would appear to circumvent this limitation. The idea was ingenious. Four electrodes were applied to the patient in such a way that imaginary fields between diagonally opposed electrodes crossed at right angles in the center of the part under treatment. A system of switches worked by electrically driven cams directed the diathermy current, first to one set of opposed electrodes, then to the other and so on.

In theory, with currents producing a sensation of moderate warmth under the electrodes, one should obtain a greater rise of temperature in the deeper tissues where the two fields cross, than could otherwise be expected where resistance and current density are lower and the circulation is more intense.

In practice, the necessary conditions for this should be easy to obtain, but what is not so easily achieved is docility on the part of the current. Indeed, unless unduly small electrodes are used, the current adopts the alternative path offered by the presence of the idle electrodes.

Figure 1 shows that unless the resistance of the path a. b. + c. d. is greater than the direct path a. d., the major portion of the current will adopt a very superficial path as shown in left side, illustration (A). To obtain an effective cross-firing as depicted in B (right side), the electrodes will have to be very small. Even then, it is doubtful whether some appreciable amount of current will not be deflected by the other electrodes.

Concentration of the field in deep tissues is not the invariable aim of cross-firing. Its object is often the thorough treatment of hollow organs of laminated structures. This applies particularly to the treatment of paranasal accessory air sinuses partially or fully pneumatized, the trachea, and even the lungs. It is obvious that on account of their conformation, these

* Read at the Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 8, 1939.

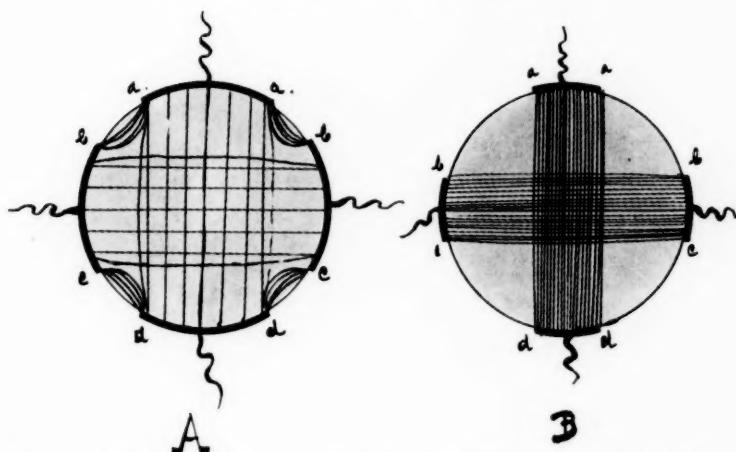


Fig. 1. — *A*, Superficial pathway of current due to encountered resistance; *B*, pathway of current due to effective cross-firing by suitable electrode arrangement.

organs cannot be treated in their entirety with the field oriented in one direction only.

A glance at figure 2 will show how, with the field as represented by lines, the walls *a*, *c*, and *b*, *d*, are being treated but not *a*, *b*, and *c*, *d*. The treatment of such a hollow organ could not be considered complete unless the field were rotated through a right angle for a second application.

The simplification of technic which resulted from the advent of ultra-high frequency currents to the realm of physical medicine to a great extent has solved the problems which did beset cross-firing with currents of lower frequency.

The fact that with short wave therapy, edge effects are negligible even when co-planar methods are adopted, has increased the number of alternative electrode positions applicable to one organ.

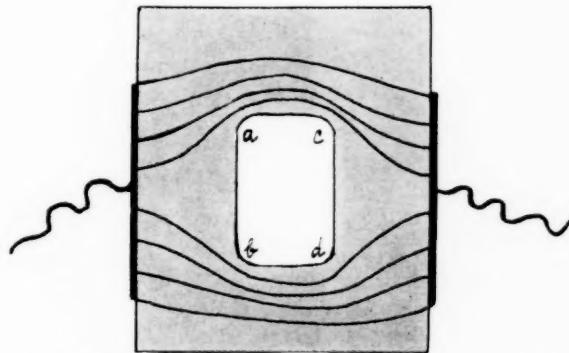


Fig. 2. — Schematic action of current passing through hollow viscus. See text for explanation.

Cross-Fire Technic

If one accepts the theory that short waves have a therapeutic value which is independent of its thermogenic properties, or if one wishes merely to ensure that an organ is treated from more than one angle, then, there can be no objection to the procedures which have just been described, where the individual treatments succeed one another within reasonable intervals.

This may well be compared with similar technics adopted where physical agents like x-rays are concerned, and of which the effects on tissues are cumulative.

Although I am of the opinion that an open mind should be kept with regard to the contention that ultra-high frequency currents might have some action not directly imputable to their conversion into heat, I realize that the local rise in temperature which can be produced by their means in the tissues is of the greatest importance. I therefore join the ranks of those who use them for the production of high degrees of local pyrexia.

Unfortunately those who have used short wave fields or experimented with them have now been forced to conclude that although this agent has simplified the technic and has overcome many of the drawbacks of diathermy, it has not the desirable faculty of heating deep tissues exclusively. The unavoidable subcutaneous fat still presents difficulties due to overheating, which are only very partially obviated by the use of very high frequencies.

Lately I have devised an apparatus with which continuous cross-firing is obtained by means of electrodes rotating in such a manner as to be 180 degrees out of phase.

In the experimental apparatus, the electrodes assume the shape of segments of a circle and are of lesser dimension than the semi-circle.

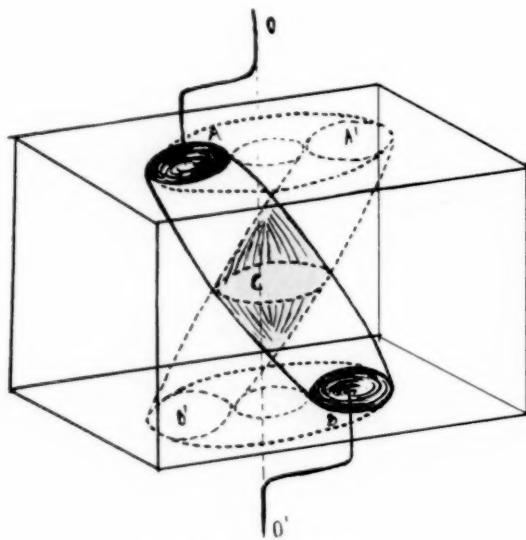


Fig. 3. — For description see text.

The material part of the apparatus consists of two pyrex glass covers inside which the electrodes rotate. To ensure mobility of the electrodes, the drive is flexible, and to enable the phase to be adjusted, a differential gear is fitted to one of the drives.

The simplest way of looking at this question, is to visualize two small circular electrodes A and B as represented in figure 3, both rotating in the same direction with the same angular velocity about the axis 0-0' but 180 degrees out of phase, over the parallel surfaces of a block of a suitable medium. It is obvious that on the surfaces, the areas covered by the electrodes in the course of one revolution are annular in shape. Moreover, at every instant of the complete cycle, the field passes through a circle C in the depth of the tissues, which of necessity must be larger than A and B.

on account of the spreading of the lines of force in the medium. It will be observed that although the superficial layers of the medium are treated intermittently through the rotation of the field in those regions, a double conoidal mass of medium deeper down, is subjected to the action of field for the whole duration of the cycle.

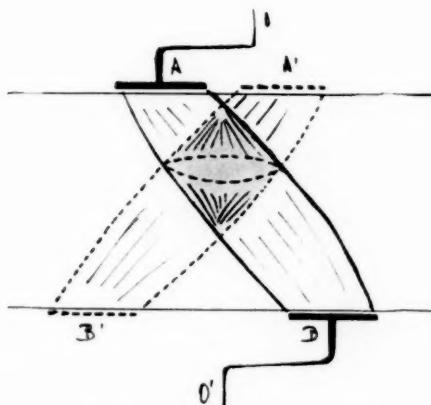


Fig. 4.—For description, see text.

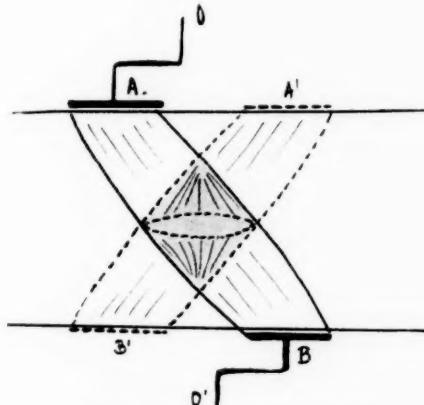


Fig. 5.—For description, see text.

The problem of the application of this method of obtaining a more intense effect in the depth of tissues, should be quite simple and resolve itself to elementary mathematics coupled with a little geometry. In practice it reduces itself to the selection of electrodes of appropriate dimensions and the adjustment of the radius of the circle described by the electrodes. These factors and others are of importance, and I propose to deal with the effects of varying them by showing some diagrams illustrating points of moment.

For the sake of clarity, only two diametrically opposed positions of the electrodes are drawn and no attempt at perspective has been made. Therefore, the shaded portions represent only the section of the part which is being cross-fired, or rather under continuous fire. The electrodes in all cases have been taken as constant in size.

In figure 4 the circles described by the two electrodes A and B have equal radii and are co-axial. Their planes of rotation are parallel.

In figure 5 the circle described by electrode B is larger than that described by electrode A. It should be noted that this brings the focus of cross-firing nearer to the surface on which the small circle is being described.

In figure 6 the electrodes describe similar circles in parallel planes but they are not co-axial.

In figure 7 similar electrodes describe similar circles but in planes of rotation which are not parallel.

In the foregoing instances, it has been assumed that the medium treated was homogeneous. It, however, must be remembered that in the human body such conditions are not encountered and that as a result, the field is distorted somewhat and only approximates the regular shape it was given in the diagram for the sake of simplicity.

The dimensions of the circular space in the center of the annular area swept by the electrode is of some importance. If it has too small a radius, cross-firing will take place too near the surface or possibly actually at the surface, as can be seen in figure 8. Again, if the space between the electrodes and skin becomes great, it should be realized that what has to be

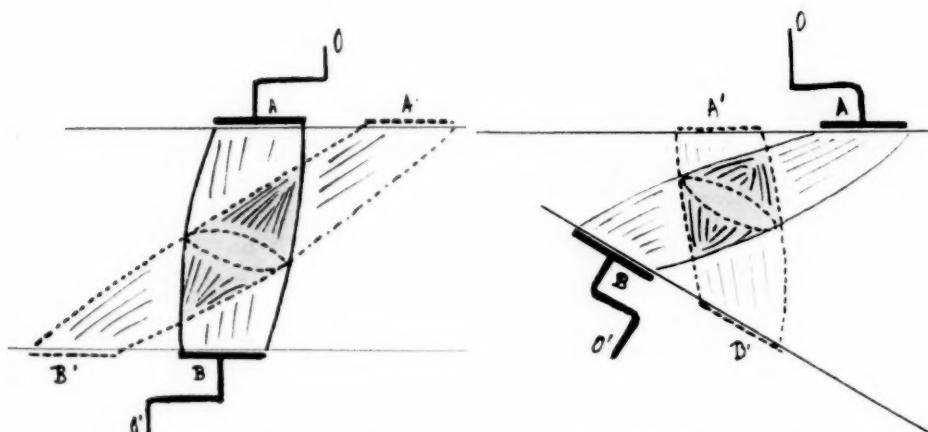


Fig. 6.—For description, see text.

Fig. 7.—For description, see text.

considered, is the dimension not of the actual, but of the virtual electrode at the skin surface.

Such occurrences, of course, entirely defeat the ends of this somewhat more elaborate method of treatment of which, as I mentioned before, the main object is to obtain continuous, and in a measure, selective treatment of deep tissues, while high impedance superficial tissues are treated only intermittently.

I have not as yet mentioned the influence of the ratio of the area of the actual electrode to that of the total annular area swept by it. To put it into mathematical form, the ratio of the area of the electrode, to that of the area swept by it, can be taken as that fraction of the time during which a point on the surface is treated in relation to the time during which the cross-fired mass is treated.

Let me illustrate this once more by means of figure 9. Here the black area represents the electrode and the shaded area the orbit in which it rotates. I have purposely drawn the former so as to be one-eighth of the area of the latter. It will be appreciated that any one portion of the shaded area, similar in shape to the electrode, will be treated for only one-eighth of the total time. In other words, it will be heated for one-eighth and cooled for seven-eighths of the duration of the cycle.

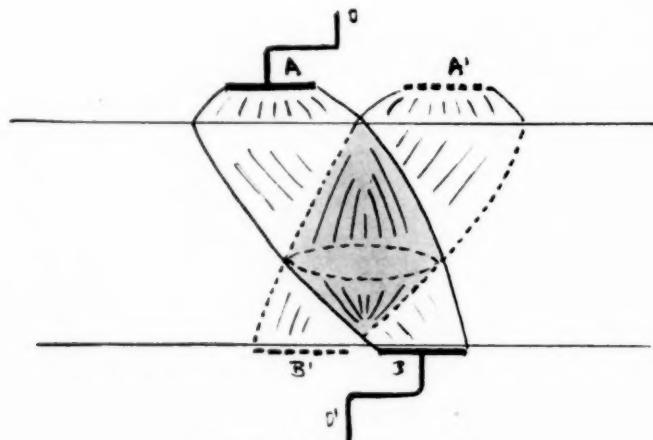


Fig. 8.—For description, see text.

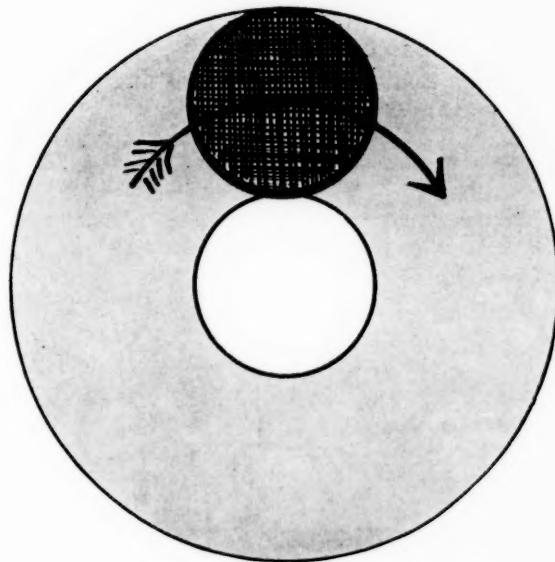


Fig. 9. — For description, see text.

Some may advance an objection to circular electrodes, which I will now point out myself. These were only made use of so far, for the purpose of simplicity.

Let us once more refer to a diagram similar to the last figure and imagine the electrode to be rotating. It immediately becomes evident that the surface which is being swept by the central portion of the electrode is being treated for a longer period than any other away from the horizontal diameter of the electrode.

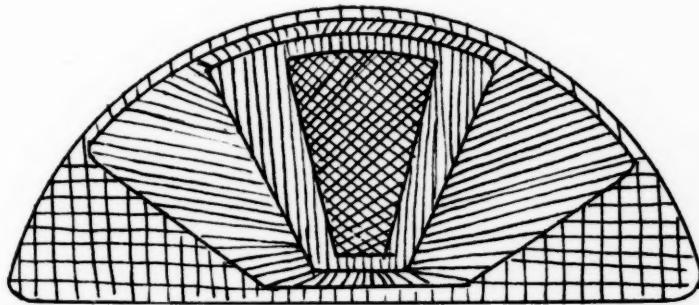


Fig. 10. — For description, see text.

• A moment's consideration will reveal that the shape of the electrode must be such, that it will correct for the difference in velocities at the periphery and at points nearer the center of rotation. The shape which suggests itself is that of the sector of a circle. But a full sector would lead us into trouble on account of overlap, at the center, or of the virtual electrodes. Therefore it should in reality be a sector, not of a circle, but of a segment of a circle, smaller than a semi-circle. This is rather involved but figure 10 makes it clear.

There remains one consideration of a technical nature — that of the generator. In the orthodox type of ultrahigh frequency generator, the oscillator circuit has a definite natural frequency and the resonator circuit,

including the patient, is brought into resonance with it by means of a variable condenser. With rotating electrodes, the capacity of the latter circuit is not constant and with these machines there would be a periodic variation in intensity of output due to cyclic detuning. It is better therefore to employ a generator where the output circuit is capacity-coupled to an oscillator incorporating an aperiodic grid circuit. Under such conditions the variations in capacity cause a slight wandering of wavelength, but this should be of no consequence except in radio and television reception.

I have had but little experience as yet with this method, which I feel certain will be of the greatest value in the treatment of pelvic organs, deep seated structures such as the hip joint — and of fat people. I have been able, however, to carry out experiments on phantom loads which have satisfied me that it is possible by exploiting the above given principles to raise the temperature in the deep tissues and effect some degree of selectivity as regard depth, in a manner unattainable by other methods.

Several reasons have prompted me to bring before this scientific body what might be criticised as a very incomplete piece of work. The primary one is the conviction that any idea which carries in it the germ of advancement is more likely to develop and mature in this fertile country than elsewhere.

There is far more experimental work to be done with this apparatus before it can be used with safety than I had anticipated when I embarked on developing it. The dosimetry is clearly more complicated than with the ordinary technic. As far as I am concerned, it is entirely empirical and I would more than welcome a discussion on the possibilities of applying established dosimetric methods to this procedure.

(Discussion of this paper, page 96.)



NEWER ASPECTS OF DOSAGE AND TECHNIC IN SHORT WAVE DIATHERMY *

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and

E. MITTELMANN, Eng.D., Ph.D.

CHICAGO

Short wave therapy today is restricted in its clinical control by the circumstance that precision in dosage is still a matter of empiricism. It is generally conceded that the sole available method of estimating the applied current depends upon the sensitivity of the individual patient. Ever since the introduction of short wave diathermy there has been a widely expressed dissatisfaction with this method of administration. It was early recognized that the subjective phenomenon of temperature sensitivity of individuals is a variable factor subject to changes according to the patient's milieu and therefore unreliable in its scientific evaluation. The situation may be compared with the prescription of any drug given with the direction to take a quantity according to the effect it will produce. The administration of drugs today is solely a matter of dosage, because it was determined by countless pharmacologic and physiologic experiments until minimal and maximal effects for definite conditions were attained. Accordingly, any physician who would administer a potent or important drug by what may be called a "pinch or guess" dosage would justly be condemned as a crude empiricist devoid of all appreciation of scientifically controlled therapy.

Translated into terms of physical therapy this implies that the application of short wave diathermy by the "pinch and guess" method as practiced today is wholly inadequate and scientifically unreliable in the sense of proper control. As a corollary it follows that dosage and technic are one and indivisible, or otherwise expressed, correct technic is impossible without precise dosage. That this is so is evidenced by a number of efforts to determine the dosage of the short wave current not as it leaves the apparatus but as it reaches and enters the human body. Praiseworthy as such efforts were, it is unfortunate that virtually all that have so far been advanced have not proved acceptable in actual practice. Apart from their complicated nature presupposing familiarity with intricate mathematical formulae, it was found that they were unreliable or unsatisfactory for our needs. It is natural that even if the results of computations would be sufficiently exact to facilitate repetition under conditions confronted in actual practice, such a method lacks the simplicity and directness required by all clinicians. Any method of dosage measurement must be not only simple and direct, comparable to the reading of a thermometer or the scale of a manometer, but must also have stood the most exacting tests both in the laboratory and at the bedside.

Experimental Evidence

Our studies to meet the needs of exact dosage and precise technic are based on experimental and clinical principles that can be duplicated by those familiar with the necessary procedures. These involve an explanation of the behavior of various tissues under short wave therapy, first, by simple experiments on phantoms and second, by their correlation with actual clinical material.

As regards the former, it may properly be objected to because they are in a

* From the Department of Physical Therapy, Rush Medical College University of Chicago.
* Read at the Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 8, 1939.

static condition lacking any influence exerted by the dynamic circulation in living beings. This holds true for the temperature elevation in the various tissues in the relation to the time of exposure if the tissues are not in a state of quasi-stationary thermal equilibrium. The difference between phantoms and living tissue becomes obvious after comparing the results shown in figures 1 and 2.

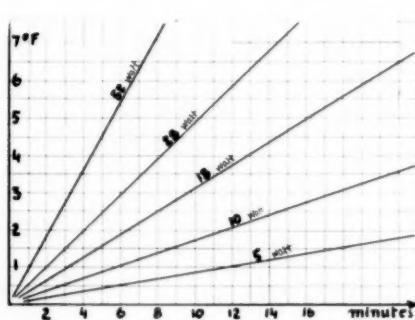


Fig. 1.—Temperature elevation as a function of wattage and time of exposure in static systems.

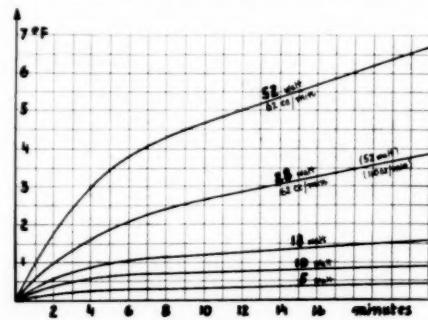


Fig. 2.—Temperature elevation as a function of wattage and time of exposure in systems with circulation. The degree of cooling is an important variable.

Figure 1 shows the temperature elevations as a function of time for different values of power absorption in a phantom without circulation. In this experiment the temperature elevation is proportionate to the time of exposure and to the power absorbed by the object. If the volume of the phantom is known, the temperature rise can be predicted by measurement of the power absorption, or the power absorption can be calculated from the measured differences between the initial and final temperatures. The experimental conditions of short wave heating become complicated when a system of circulation with its cooling property replaces the static system.

To investigate the influence of a cooling system we constructed a model containing an electrolytic solution under conditions simulating natural circulation with the possibility of controlling the rate of velocity of the circulating fluid (fig. 3). The temperatures of the phantom and of the cooling system were identical at the start of the tests, and the temperature of the circulating fluid was kept constant. Prediction of the elevation in temperature of an object under the influence of a cooling system becomes more difficult than with a static system. Depending on the velocity of the circulation, a smaller or larger part of the calories supplied by the short wave field is carried off by the cooling stream. As was pointed out, figure 2 shows the relation between the temperature rise, power absorption and time of exposure as compared with that of figure 1. The circulation of the cooling fluid was adjusted in this experiment to the normal amount of blood flow in the human body, that is, 62 ccm per kilogram per minute. Analysis of figure 2 shows that even in the case of a cooling circulation, there is a direct ratio between the power absorption by the object in terms of wattage and the rise in temperature. For any given moment the temperature elevation in the object will be proportionate to the amount of the absorbed high frequency energy measured in watts; in other words, the ratio between the values of corresponding temperature rise and power absorption are the same at any instance. Depending on the velocity of the circulation a state of dynamic equilibrium will be reached after a certain time, after which the temperature again rises uniformly per minute. We will see later how this characteristic behavior of the temperature elevation is affected by more complicated conditions, such as the presence of various tissues with different coefficients of power absorption and of specific heat.

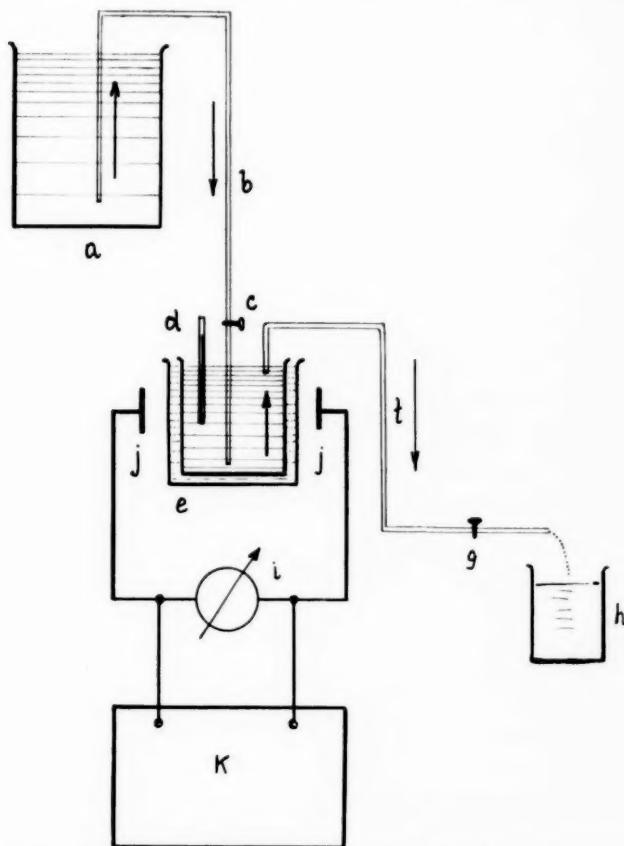


Fig. 3.—Schematic diagram of the experimental setup for the determination of the temperature elevation in phantoms with a circulating system. a, 50000 ccm water tank (electrolyte); b, pipe; c, valve; d, 1000 ccm electrolyte; e, oil; f, pipe; g, valve; h, calibrated jar; i, high frequency wattmeter; j, electrodes; k, short wave generator.

We next investigated the influence of the variation in circulating velocity. For this purpose the power absorption was kept constant and the circulation, that is the amount of the cooling fluid per minute, was varied. These experiments yielded temperature curves similar in character to that of variation of the power absorption. Actually each of the curves can be obtained either by the variation of the cooling rate or of the power absorption, as demonstrated in figure 2. Its practical significance lies in the deduction that the final temperature of tissues taken after a short wave treatment is by no means a measure of the actual power absorption and therefore no guide for exact dosage. The same final temperature can be achieved with entirely different values of power absorption depending on the actual value of the cooling rate of the circulation.

The final temperature, however, is only a single phenomenon, and does not point to what might take place during the different periods of the treatment shown in figure 4. Bierman reported that measurements of the temperature of deep tissue during and after application of short wave on living subjects showed a higher temperature at ten to twelve minutes than at the end of a twenty minute exposure. The curves in figure 4 represent the temperature elevation in the object for constant power absorption and various cooling rates. The broken line corresponds to a system with very restricted or no circulation. At the start of the experiment the temperature follows the line of normal circulation, but soon rises higher than we could ever obtain with a circulation that

remains unchanged or is increased. The temperature follows the line of a restricted cooling rate, comparable to an initial vasoconstriction in the deep tissues which occurs at the beginning of actual treatment. After the temperature has reached a certain maximal value it will decline again, indicating that it now follows a line of increased circulation (vasodilatation), which is more rapid than the original circulation at the beginning of treatment. This behavior which corresponds to the characteristic of strong dosages accompanied by a high surface heat up to the patient's tolerance, is possibly explained by the well known physiologic experiments in animals by Rein showing a reduction in blood flow in the deep tissues by the application of intensive surface heat (fig. 5). This explanation is in accord with the findings of Cignoli dealing with human subjects and short wave therapy.

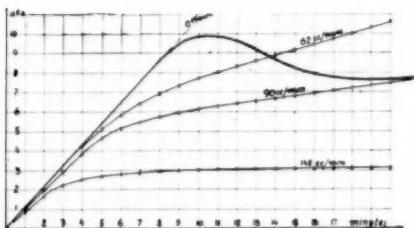


Fig. 4.—Temperature as a function of wattage and time in systems with a controlled but changing cooling rate.

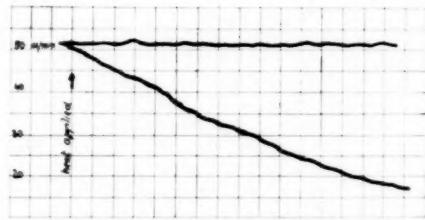


Fig. 5.—Experiment in dogs showing a constriction of the deeper tissues and vasodilation of the superficial after application of surface heat (After Rein⁹).

We then investigated the behavior of a complex phantom simulating actual living conditions, such as fat surrounding muscular tissues. In these studies both condenser field and cable methods of short wave heating were used. The cooling rate was again adjusted in the electrolyte to 62 ccm per minute per kilogram. No cooling system was used in the oil surrounding the electrolyte except the environmental air. In order closely to reproduce living conditions and allow a better cooling of the oil, both the electrolyte and the oil were raised to the respective temperatures in the living tissues of 95 and 98 F. The cooling fluid had a constant temperature of 98 F. Figure 6 shows the heating curves of oil and electrolyte corresponding to the muscular and fatty tissues in a phantom without a cooling circulation. It is important to bear in mind that fatty tissues in a condenser field are heated better not only according to the high voltage drop along them, but also according to the low specific heat of the adipose tissues (0.4) as compared with the higher specific heat of the muscular tissues (0.95). The same amount of power absorption per volume unit in the fatty tissues raises the temperature by over a double amount as compared with the muscular tissues. The total power absorption was measured with the wattmeter, devised by one of us (M.). Figure 7 shows the phantom with circulation in which the power absorption was measured and adjusted to the values given in figure 4.

If inductive heating is used, the results are different (figs. 8, 9). It is of clinical interest to note that with this procedure the conductive tissues always maintain a higher temperature than the surrounding fat. The fact that similar final temperatures in living beings were measured on various occasions does not necessarily imply that the tissues would show the same behavior when submitted to short wave heating by different methods. It is important to know the final temperature obtained and more so in what way it varied and could be duplicated in practice.

In either case knowledge of the power absorption is of prime importance. We will see later how the physiologic responses can be influenced in a reproducible way, if the power absorption by the object is known.

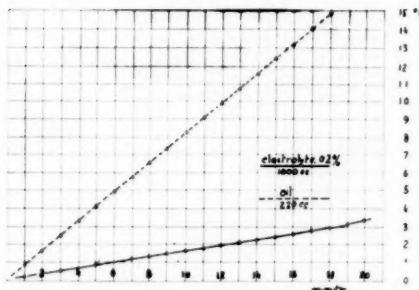


Fig. 6.—Heating conditions of a static system with no circulation in a condenser field simulating both a fatty (oil) and muscular (electrolyte) environment.

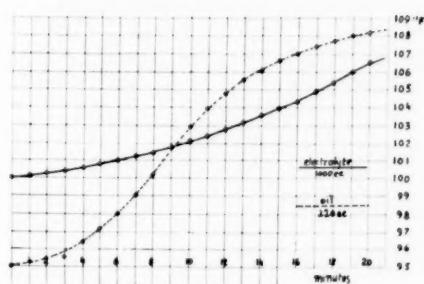


Fig. 7.—Temperature elevations in a system simulating fatty (oil) and muscular (electrolyte) tissues in a condenser field after introduction of a cooling circulation.

Clinical Investigations

The above described physical experiments were followed up with clinical investigations to find a practical basis of comparison. These were carried out on a large series of cases before we drew any conclusions. Three groups of one

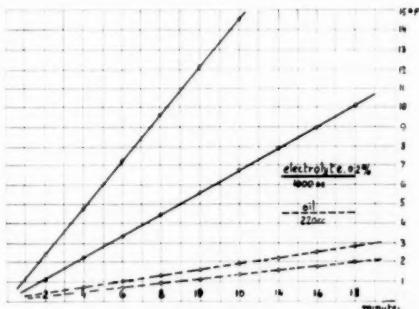


Fig. 8.—Heating condition for oil and electrolyte treated in a magnetic field of a static system.

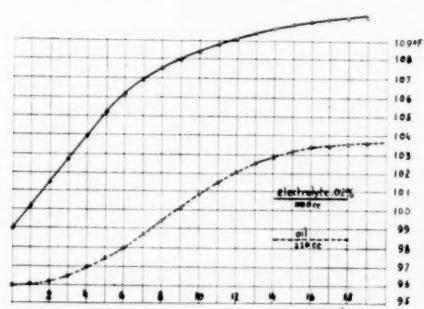


Fig. 9.—Temperature elevation of oil and electrolyte in a magnetic field after introduction of a cooling circulation.

hundred patients were submitted to short wave treatments by various techniques and at various locations. At first no dosage control was used, and reliance was had on the statements of patients that they felt a "distinct but agreeable heat sensation." The probability of producing similar effects in various cases was studied. Each patient was treated twenty minutes. The pulse rate was measured before and after each treatment. For the purpose of a common basis of comparison the percentage changes rather than the absolute values of the difference were calculated for each case from the initial and final readings. In figures 6, 7 and 8, each line represents a patient, and the length of the lines is proportional to the percentage increase or decrease in the pulse rate as compared to the initial rate. The dots indicate that no change has taken place. In the case of pad electrodes, 38 patients responded with an increase, 34 with a decrease of the pulse rate, and 28 did not show any change. The average value of the percentage change is virtually the same for increase and decrease (fig. 10).

The tendency is shifted toward positive changes in the pulse rate if air spaced electrodes are used, as shown in figure 11. More patients manifested an increase, with the absolute values of the positive changes higher than when pad electrodes were used.

A distinct tendency for an increase in pulse rate is revealed by the treatments with the induction cable in about 75 per cent of all the cases. The average values of the absolute changes are higher than in the treatments with the con-

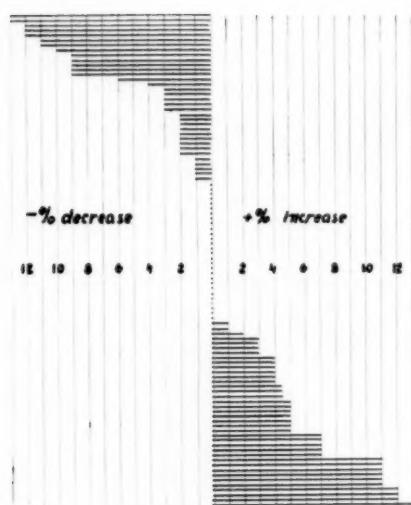


Fig. 10.—Distribution of the changes in pulse rate after treatments in condenser field using pad electrodes.

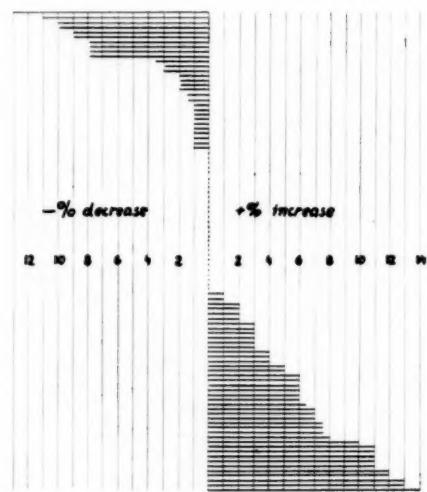


Fig. 11.—Distribution of the changes in pulse rate in condenser field using air spaced electrodes.

denser field. Similar measurements were made with the flat or pancake coil, with the result of a slightly lower percentage of positive responses (fig. 12).

From the curves shown in the preceding figures the probability was calculated for the various percentage values of a positive increase in pulse rate. The vertical ordinates indicate the percentage of the total cases that will respond with at least the same percentage indicated by the values on the horizontal abscissae (fig. 13).

The different heating properties of the various methods and the possible variations in energy distribution, no doubt account for the curves. The induction method heats the vascular tissues best from the start of the treatment, thus giving a response with a marked dilatation and causing an increase of the cir-

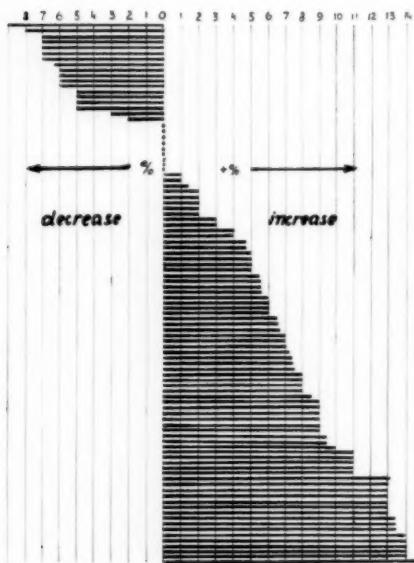


Fig. 12.—Distribution of the changes in pulse rate after treatments using the induction cable technic.

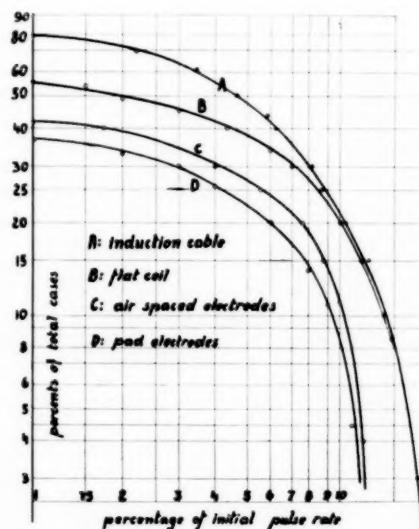


Fig. 13.—Curves of probable distribution of the changes in pulse rate after treatments with various methods.

culation. When applying the condenser field method the immediate physiologic reaction will depend upon the ratio between heating of the deep and of the adipose tissues. With the flat coil the result is influenced by the degree of deep penetration. This is usually less uniform than with the cable and will depend upon the capacitive effects of the windings against the body. The influence of the capacitive component will be the greater the lower the wavelength.

Figure 14 shows to what extent the physiologic responses can be controlled by a proper measurement of the power absorbed during the treatment. The

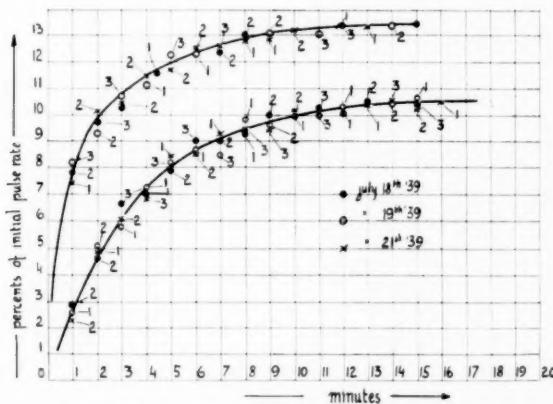


Fig. 14. — Percentage changes in pulse rate as a function of time and dosage. Three individuals (1), male, age 36, initial pulse rate 76; (2), male, age 37, initial pulse rate 72 and (3), age 28, initial pulse rate 69, were treated.

curves represent the average values of the percentage increase in pulse rate for an induction cable treatment as a function of time, and of various values of the power absorbed by the patient. Three turns of the cable were wrapped around the thigh. The circles, dots and crosses in the chart correspond to measurements made on various days and illustrate the ability to repeat the dose of a treatment. The indices next to these signs refer to different subjects. Significant in all cases is the immediate increase in the pulse rate after the first minute of treatment. The tendency to maintain the increased pulse rate during the treatment is illustrated in all curves.

Applied Technic

Before presenting the deductions to be drawn from the above described laboratory and clinical studies with particular reference to their applicability in actual practice, it is essential to point out several factors of importance. We have seen that there is a great difference in the effect of short wave diathermy between static bodies and those provided with a circulation. The role of the circulation of the blood in cooling any form of application of heat is well known, but at times interpreted improperly so far as a difference between physiologic and pathologic processes is concerned. Accordingly there is a contrast when making temperature measurements, both superficial and deep, on healthy structures with a normal circulation and on those affected by disease in which systemic reactions have already produced a state of local congestion and tissue changes. The conclusions drawn from the former are not directly applicable to the latter. This is clearly shown in our experiments which bring out the sharp variation between bodies with different cooling circulation. Under the circumstances it is evident that the indiscriminate application of short wave diathermy of virtually unknown dosage may be useful in some cases and harmful in others, all depending on the nature of the pathologic process.

For purpose of illustration let us assume one patient to be suffering from endarteritis obliterans and another from chronic arthritis. It is evident that in either case the dosage must be regulated according to the volume of the part as well as the amount of the circulatory flow, such dosage in these cases being best expressed in terms of wattage. It hardly needs stressing that in conditions involving vascular sclerosis with its limitation of local circulation the intensity of the treatment must be considerably less than in inflammatory processes, including those due to infection with their local circulation in a state of passive hyperemia and congested blood supply.

While such examples can be multiplied *ad infinitum* the two just mentioned bring out the underlying conditions and principles so clearly that further comment would seem superfluous. It should be added, however, that dosage implies more than wattage because the time element also plays a decided role. It has been seen from the experiments on the circulating system that the effects vary within the course of a conventional 20 minute treatment. If strong dosage approaching the patient's tolerance is applied, the maximum rise in deep tissue temperature and a corresponding increase of the blood circulation might be achieved after a treatment period of 10 to 12 minutes. This observation therefore shows the impracticability of such treatments when prolonged beyond that period.

The experiments and clinical observations furthermore convey valuable directions with regard to the application of the various technics of short wave diathermy. This is particularly important because of the widespread differences of opinion with regard to the effectiveness of the condenser electrodes, air-spaced electrodes and induction cables. Many authors seem to accept the view that any one method is applicable to all conditions. Our experiments show that all such conceptions are erroneous because they ignore the factor of differential heating of diverse tissues, particularly of fat as contrasted with muscular structures. This phase of our problem involves anatomic considerations which must be weighed in each individual case. Thus for example, if one is called upon to treat an abdominal viscous or even a condition commonly referred to as low back pain, it is clear that the large amount of fat deposit in these regions often prevents a successful reaction through the improper choice of electrodes and the method of application. Accordingly there are definite indications for the use of air-spaced electrodes in regions poor in fat, and the use of the induction cable when there is an abundance of fat.

These indications are by no means merely theoretical, because figures 4 and 5 show the difference in heating effects through adipose tissues when condenser or induction methods are used. It is seen that the induction cable exerts a greater heating effect upon electrolytic solutions resembling muscular tissues at the expense of the outer fatty structure, while with capacitive heating there is produced the very opposite effect. At the same time it should not be left unmentioned that not all coils have an identical result, our experiments having shown that the spacing between the individual turns has a variable effect, so that coils placed closely together will produce an electrostatic action similar to that of condenser electrodes. It follows that for inductive effects it is essential that the individual coils must be separated from each other by a distance at least that of the cross-section of the cable and that direct contact with the underlying structures must be avoided.

Again, our studies of the pulse rate present a problem of great importance. Given a case of cardiac disease or hyperthyroidism, or other conditions accompanied by tachycardia, the selection of the method of treatment is not of indifference. Reverting to figures 6 to 9 it will be noted that the highest pulse rate is produced by the induction method, while the pad electrodes have the least influ-

ence. Accordingly, in all conditions accompanied by an accelerated pulse or those with a tendency toward a rising pulse rate it would be irrational to ignore the advantage of pad electrodes, and equally improper to make use of the induction cable. It is realized that these studies are far from being completed in every detail, but sufficient has been shown to stress the great need for placing short wave therapy on a scientific basis through proper selection of method and adequate control of dosage both in intensity and time. It is only by the application of scientific methods that we can anticipate uniform results.

Summary

1. Experimental and clinical studies are presented which show that precise dosage is essential in short wave therapy.
2. It has been established that there exist differences between a static system and one provided with a circulation, the latter revealing temperature modulations depending upon the time of exposure, the power absorbed by the object and the degree of cooling effect as demonstrated by exact dosage measurement.
3. Fatty and muscular tissues are the two principal factors in differential heating, with the induction field producing a greater effect on muscular structures and the condenser field objectionable overheating of adipose tissues. The technic therefore must be varied to meet both anatomic and pathologic conditions.
4. The relationship of the pulse rate to the various technics of heating has been demonstrated. Both the condenser and induction methods have special and different values. The induction cable accelerates the pulse rate while the condenser pad has the least effect. Accordingly the clinical implication is that these two methods must be selected with care in clinical practice with reference to conditions characterized by bradycardia and those by tachycardia.
5. The time element plays a role in dosage to the extent that a maximum rise of temperature is achieved within 10 to 12 minutes if strong dosages are applied approaching tolerance of the patient. Accordingly prolongation of that period is a matter of clinical indication.
6. The method of actual measurement of dosage here presented has been found by us to be as simple as it is precise. Its facility of being repeated at will assures exactness of dosage.

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Discussions of Papers of Drs. P. Bauwens, Kobak and Mittelmann, and F. H. Krusen and M. Brunner.*

Mr. Myron M. Schwarzschild (New York): The question of dosage in short wave therapy has always been close to my heart. Many aspects have been considered, and much has been said on this question in the past. While the problem remains unsolved, the papers presented today undoubtedly signify a forward step.

Before proceeding with the paper strictly devoted to the dosage problem a few remarks are in order in connection with those devoted to improvements in technic. Drs. Brunner and Krusen themselves have stated that the idea presented is not a new one. Multiple electrodes have been used in conventional diathermy, in which suitable rheostats are sufficient for the control of the current in the various branches. Also in the short wave field attempts of a slightly different nature from those here reported have been made. The method of Dr. Bierman and myself using the pick-up plate in the 30-meter fever apparatus field, and the use of a tuned pick-up for the third electrode, as done in France, are examples of multiple electrodes in the short wave field, which differ in a rather significant manner from the method of Krusen and Brunner. We may look upon their system as providing two active electrodes, while the older systems referred to used two inactive electrodes. This distinction is not a sharp one since the differentiation of electrodes into these two classes is merely a matter of degree. The difference is, however, probably responsible for the technical difficulties which had to be overcome in the work reported here. The importance of the method must lie in its clinical results and not in the physical novelty.

The other paper on technic seems to have an opposite end in view. Dr. Bauwens presents us with an ingenious and apparently effective method for increasing the concentration of heat internally while Drs. Krusen and Brunner have aimed at a more uniform distribution of dosage. Undoubtedly there are conditions in which one or the other of these effects is desired.

Since Dr. Bauwens himself has mentioned the use of cross-fire in x-ray therapy, I should like to call attention to the fact that quite a long time ago Knox, also in England, I believe, conceived the idea of rotating the portal during x-ray therapy so as to obtain a continuous cross fire analogous to that presented here for the short wave current. Knox's method never became important because it was realized that the simultaneity of treatment from various directions yielded no advantage. The treatment could be divided, one sitting being given through one portal, the next through another, and so on until the whole circle was covered. This should not be the case with short wave current because here we do not deal with a cumulative effect, but rather with one in which

the summation of effects over only very short periods is of significance. It is not the total energy delivered, but rather the average power, or rate of delivery, which is of prime importance. A treatment of 5 hours at 20 watts is not equivalent to one of a single hour at 100 watts. In the first case the attained temperature may never be sufficient to cause any physiologic effect, while in the second such changes are appreciable. If the technical complications are not serious it would seem that Bauwens' method is of value. The advantage is, I believe, somewhat less than indicated by the area ratios. Is it not possible with fixed electrodes of suitable shape, size and position to obtain a much better depth effect than with the Bauwens electrodes at rest?

Early in the development of local short wave therapy many workers, including ourselves, realized that the energy delivered to the tissue is not all converted into a manifest rise of temperature. As matter of fact, on any reasonable assumption as to the amount of power dissipated in the patient, the calculated rise in temperature far exceeded any measured amounts. This difference is so considerable that in 1936, we pointed out that the actual temperature rise to be expected in the vagina when vaginal electrode therapy is administered is of the order of 10 per cent of the theoretic value obtained from a consideration of field distribution on the assumption that the available power output of the apparatus is actually delivered. Even allowing for a 30 per cent effectiveness of the apparatus there still remains a factor of about 3 per cent unaccounted for. The explanation for this discrepancy between observed temperature rise in the living, and calculated temperature rise in an inert mass was attributed to the cooling of the circulation.

The essential correctness of this explanation is now indubitably proved by the work of Kobak and Mittelmann reported today.

We must distinguish between two possible causes for the effectiveness of any thermal therapy. One effect is due to the rise in temperature per se. The other, and separate, effect is due to the induced hyperemia. This latter usually acts to reduce the temperature rise. Thus, an extremely effective treatment from the point of view of hyperemia, may result in a negligible rise in temperature. For this reason the efficacy of a particular technic cannot always be judged by the induced temperature rise. It may even happen that a large concentration of power results in a lower temperature elevation than would be produced by a lesser amount of power. It is for this reason that too much significance cannot be attached to the relative heating by different methods. While there is no reason to assume any effect of the short wave current other than heat, the degree of temperature rise alone is not a

* Article by Drs. F. H. Krusen and M. Brunner appeared in January, 1940, issue. — Ed.

sufficient basis for judgment of the effectiveness of a given wavelength, or generator. It is conceivable, for example, that a modality which delivers heat throughout the tissues of a limb might result in a lower temperature rise, even in depth, than one which concentrates more of the heat on the surface. This must be borne in mind when comparing short wave and conventional diathermy, for example, and should be considered in the testing of transmitters. While not directly pertaining to this discussion, I should like to point out that the comparison of apparatus by means of the attained temperature in the living is untenable when the arrangement of electrodes is not consistently comparable.

Drs. Kobak and Mittelmann have beautifully demonstrated that fat is heated more than muscle in the condenser field, while in the coil the situation is reversed. This is reasonable and is the result of altered geometry. The current flow is in different directions with respect to the fat and muscle layers in the two cases. But condenser terminals may be arranged to produce the same effects as the coil, and vice versa. The distinction is not intrinsic with the method, but depends on the geometry of the system.

The fact that the temperature rise is not a monotonic function of time, i.e. does not rise continuously but passes through a maximum and falls with continued treatment, is explained by the phantom experiments. These show that the observed phenomena can be explained on the assumption of the occurrence of a definite increase in blood flow at about the time of the maximum. There appears to be an implication that the maximum always occurs after 10 to 12 minutes of treatment. Do not the type of application and the dosage affect this time? In many cases short wave therapy is administered because of the beneficial effects of an increased blood flow. Why then does Dr. Kobak recommend that treatments should end at precisely the time at which according to their own work the increase begins?

Drs. Kobak and Mittelmann have touched on the use of the wattmeter devised by Mittelmann for dosage measurements. It should be mentioned, lest there be misunderstanding, that the wattmeter is a device which measures the power delivered to the patient, but not the concentration of power. Thus, a wattmeter measurement is useful and has been applied to duplicate results for a given setup. It might also be used to compare dosage for the same arrangement of electrodes at different wavelengths, not too far apart. When the setup is changed, however, new values of wattage must be used, lest there be undue power concentrations and over-heating. The amount of wattage needed can be determined only by further experiments in which the correct wattage for every conceivable type of setup is determined.

Drs. Kobak and Mittelmann have shown a specific difference between the effect on

the pulse rate between the induction coil and condenser methods. Is not such a generalization rather extreme? The arrangement of condenser plates, the region treated and a host of other factors should be expected to influence such a complicated physiologic reaction.

I cannot permit my discussion to end on this note of criticism. The papers presented are the outcome of much diligent effort and represent valuable contributions toward a better understanding and solution of the problems of short wave therapy.

Dr. Charles Sheard (Rochester, Minn.): The importance of the measurement of dosage has been called to our attention once again by Drs. Kobak and Mittelmann. Obviously correct technic is impossible without reasonable precise dosage. The authors have conducted various experiments on phantoms, with and without circulating (cooling) systems, presumably for the reason that the phantom, without a cooling system, would be analogous in its power absorption and rise in temperature to findings in such a static system as an amputated leg or dead animal, while the power absorption in the intact limb, or in a living animal, would be similar to the phenomenon observed, to the first order of approximation, with a phantom having a circulating system.

In the first place, it is undoubtedly true that, in a phantom in the static state, the elevation of temperature will be proportional to the time of exposure and the power absorbed by the object. If the volume of the phantom is known, the rise in temperature can be predicted by measurement of the power absorption, and vice versa. More exactly, I should say that the statement should be made as follows: Since, according to the first law of thermodynamics, the heat (in calories) developed is proportional to the power absorption (in watts), i.e., $W = I H$ and since the heat (in calories) produced by the absorption of energy is equal to the mass (m) of the body heated, multiplied by this specific heat (s) and the rise in temperature ($t_1 - t_2$), i.e., $H = m s (t_1 - t_2)$, it follows that the rise of temperature of the body heated is proportional to the power absorption if (1) the specific heats of absorbing materials are uniform and (2) if there is no loss of heat from the surface of the body or a temperature gradient from deeper to more superficial areas. Non-living material, such as a dead dog, is a static system but the specific heats of its various tissues, such as fat, muscle and bone, differ considerably. For example, the same amount of power absorption per unit volume in the fatty tissues raises the temperature by a double amount as compared with muscular tissues. Hence, as I see it, the experimental phantom and the actual phantom of dead tissues with various types of tissue are not exactly comparable. It would seem as though such a phantom should be built with appropriately placed layers or sections of oil and electrolyte, respectively, to represent fatty and muscular tissue. Drs. Kobak

and Mittelmann present very clearly the significance of fat and muscle tissue in electrostatic (condenser) and electromagnetic (inductive) fields and the treatment of choice in certain clinical conditions.

I think that the approach of Drs. Kobak and Mittelmann to the problem of the power absorption of a body with a circulating medium such as blood, which they refer to as the cooling circulation, is to be commended. But it is a difficult approach: the experimental conditions of short wave heating become complicated when a system of circulation, with its cooling ability, quite largely or at least partially replaces the static system. Power absorption may be kept constant and the amount of circulating fluid per minute varied, or vice versa. In other words, rate of heat production may be kept constant and rate of cooling by the circulating system may be varied by changing the speed of the circulation. I believe that we may accept the experimental data of Kobak and Mittelmann on the effects of the circulating medium, the blood, on the heat produced in tissue. Adjusting the circulating fluid to about 62 cc. per kilogram per minute (or normal rate of blood flow), they found that there is a direct ratio between the power absorption, in terms of wattage, by the object and the rise in temperature. Obviously a state of dynamic equilibrium will be reached at such a time and under such conditions of velocity of circulating fluid as will permit of equality of heat production and heat loss.

All of these and many other statements in the paper of Drs. Kobak and Mittelmann may be true and they are to be congratulated on their investigations which throw considerable light on the problem of dosage, significance of temperature of tissue and germane topics. But it seems to me that phantoms, either static or with dynamic features of circulating fluid, can hardly begin to approximate the complexity of the living body, with its heat regulating mechanism, its various methods of controlling heat loss, its variations in peripheral vasoconstriction and vasodilation, and so forth. Furthermore, the circulating fluid, the blood, is in a closed system with many ramifications and branches; there is a nicety of adjustment to maintain constancy of rectal (body) temperature and all manner of shifts of blood, increased circulation and so forth, may take place both superficially and internally. Hence I believe we should be careful in applying to the living body the conclusions drawn by Drs. Kobak and Mittelmann from their use of static and dynamic phantoms. If correct, their conclusion that a maximal rise of temperature is achieved within ten to twelve minutes and prolongation of that period is superfluous, is of importance.

I believe that nearly all those acquainted with this field of scientific investigation will subscribe to the conclusions relative

to the effects of capacitive or inductive heating on fat and muscle tissues and on the relationships of pulse rates to the methods of heating.

Mr. Howard A. Carter (Chicago): The authors have described in this paper a method of estimating dosage for short wave diathermy. Evidence has been presented to substantiate the accuracy of the dosage by means of the calorimeter. It would appear from these findings that accuracy might be expected to within 10 per cent.

The authors would have presented more convincing evidence if the dosage meter had been checked by heating experiments in the live human thigh. For example, evidence to show that a desired temperature of 103 degrees in deep tissue could be assured with reasonable accuracy by reading the meter. A series of investigations correlating the temperature in the deep tissues with the power input in watts would be valuable.

Dr. P. Bauwens (closing): My discussors drew attention to a point which is rather important, and which, if I may be allowed a minute, I should like to settle. Since writing my paper, I have had an opportunity of doing an experiment which, though far from conclusive, does give some indication. I took two individuals and put them across one another — that is to say, I had one lying on his back, and across his abdominal part I had another individual lying. They were "tummy" to "tummy." Then two repeating electrodes were applied, one to the back of the two patients, and caused to rotate. First of all I tried the electrode standing still, and under such various conditions of spacing with the still electrode, the heating of a certain amount was found, naturally, on the superficial parts immediately under the electrodes, and little heating was found at the junction of the two patients — that is, their abdominal skins, which were in contact with one another.

When the electrodes were rotating they managed to give a great deal more power and more heating was found at the point of contact where the two patients were actually in contact with one another. The only conclusion one can derive from that, is that it is possible to dissipate greater amounts of energy when the electrodes rotate than when they are in a fixed position.

Now, remember this: I did not use various types of electrodes as was suggested by the first discusser; they were the actual electrodes I was forced to take, under one condition standing still, and rotating with the other. I must draw attention to one point, which is this, that I had to repeat this experiment and heat-insulate the back of the patients, otherwise too much heat was being lost from the superficial tissues under the electrodes. That was a precautionary measure.

Dr. Eugen Mittelmann (closing): Mr. Schwarzschild's discussion suggests the advisability of a more detailed explanation of the meaning of the curves in figure 4. The main reason for the experiments described in our report was the attempt to obtain a physical explanation of certain clinical findings. The curve having a maximum of temperature rise as illustrated in figure 4, is assumed to parallel the temperature rise in the deep tissue in the natural course of treatment. If there is no circulation or if the tissue has reached its thermal equilibrium in respect to its surrounding, a uniform supply of energy or calories per second will correspond to a uniform increase of the tissue temperature. The temperature rise follows a straight line as indicated by the dotted line in figure 4. In the presence of a cooling circulation a number of the calories supplied per second are carried away by the cooling blood stream, and therefore the temperature rise is less than in one without a circulation. There is always a continuous increase of the temperature since the number of calories supplied by the external process exceeds the number of those which are possibly carried away by the blood stream. If we are now confronted with a situation where the temperature reaches a maximum and then falls again, this phenomenon can be explained only in the following way. There may be a constriction and thus a reduction of circulation must have taken place in the beginning of the treatment. Consequently the temperature rise in the beginning is higher as it would be with a normal circulation. In the course of the continued treatment the circulation increases again and the temperature rise is levelled off due to the increased number of calories carried away by the circulation. On the other hand a similar behavior of the temperature curve might be obtained if the circulation and thus the cooling effect increases continuously in the course of treatment. If the circulation increases sufficiently a point might be reached where the amount of calories supplied by the external source and that carried away by the cooling blood stream become equal. At this point the temperature does not increase any more and the maximum rise is reached. If the circulation keeps on increasing, then more calories are carried away than the external source could possibly supply per second, for which reason the temperature drops again and finally is lower than the maximum achieved in an earlier course of the treatment. As is easily understood from these explanations the point of maximum temperature corresponds to an already highly increased circulation and it is entirely a matter of clinical experience and judgment whether it should be increased beyond this limit.

So far as the pulse rate curves corresponding to cable and condenser field methods are concerned, I would like to stress the point that these curves merely represent the grade of uncertainty of a certain response if an uncontrolled treatment is administered; that is if no dosage measurements are made. The reason for the more uniform results in case of the induction cable is obviously due to the fact that the energy distribution in the cable field does not greatly depend upon changes in the geometric configuration between object and electrodes. With the condenser field methods slight changes in the spacing of the electrodes and the like may have considerable effect on the absorption and distribution of energy as well. The demonstrated curves must not be interpreted as a possible expectancy for a certain biologic response if a reliable method of dosage control is applied. It is rather to be expected that the responses will show a considerable uniformity with all technics of application. Unfortunately we have not yet had the opportunity to complete our work in this respect.

The high frequency wattmeter measures the power absorbed by the patient, or in other words the amount of calories per second supplied to the body by the short wave therapy generator. It is the only means we possess today for an adequate quantitative measurement of the primary effects in short wave therapy. I doubt whether it will ever be possible to measure by simple means the concentration as such. It is a matter of clinical experience to find the correct values for the various treatments the same as in every other branch of therapy. Every instrument can only help the physician in the solution of his problems, but it can never replace judgment obtained by clinical experience. This is all the instrument is intended to do, and as various reports from here and abroad indicate, it is doing it satisfactorily.

Dr. Frank H. Krusen (closing): In our paper we distinctly pointed out that we claim no originality for this procedure. What we did find difficult was to get a distributor that could be applied clinically. And what Dr. Brunner has done is to perfect a simple distributor technic which we can use in our department, and which we thought might be of interest to others.

If Mr. Schwarzschild had read our paper carefully, he would have noticed that there is no need for calling our attention to the pick-up plate, which was developed by himself and Dr. Bierman. I quote directly from the paper: "The combination of general and local heating has been successfully employed by Bierman, and especially developed for the treatment of pelvic lesions." In that particular statement, we were referring to the pick-up plate.

PERIPHERAL VASCULAR DISEASES: DIAGNOSIS AND TREATMENT BY PASSIVE VASCULAR EXERCISES *

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OAKLAND, CALIFORNIA

For one hundred and forty years physicians have employed apparatus to lower the environmental pressure about an extremity in order to decrease the local resistance to the flow of blood. Although this method was used by earlier physicians to treat various lesions of the extremities through increasing the peripheral arterial blood flow, it is to the work of Herrmann and Reid,¹ and of Landis and Gibbon,² that we are indebted for our present use of this type of treatment. Working independently of each other, these two groups of investigators almost simultaneously revived the idea and perfected the mechanism by which the treatment is applied.

Since August 15, 1934, a passive vascular exercise machine, designed by Herrmann, has been in use at the Albany Hospital. From that date until June of 1938, 246 patients had been examined for suitability to treatment by the pavaex method. In this series of cases passive vascular exercise was the principal method of treatment employed to increase the peripheral circulation. Complete instructions in the hygienic care of the feet were given to each patient. In some instances these treatments were supplemented by Buerger-Allen exercises, by contrast foot baths, or by use of a heated cradle, thermostatically controlled between 92-96 F. Ulcers were treated with warm foot packs of saturated boric acid solution or azochloramide in triacetin 1:500 dilution. Three patients used the Sanders' Oscillating Bed³ along with the pavaex treatments.

Before any patient received passive vascular exercise, a complete study was made of his general and of the peripheral vascular systems. The signs and symptoms of vascular deficiency were carefully noted, and the physical examination routinely included inspection of the skin and nails for color and trophic changes; the color of the extremities on elevation and dependency; palpation of the peripheral arterial pulses; determination of skin temperatures by the Marcellus photo-electric recorder⁴; oscillometric studies of the thigh, calf, dorsalis pedis and posterior tibial arteries by the Tycos recording sphygmomanometer. In all but a few cases, the degree of potential vasodilatation was determined by the Landis-Gibbon test,⁵⁻⁶ or by anesthetization of the posterior tibial nerve.⁷⁻⁸⁻⁹⁻¹⁰⁻¹¹ When desirable, these tests have been supplemented by roentgenograms of the legs and feet and by the histamine skin reaction.¹²⁻¹³⁻¹⁴⁻¹⁵⁻¹⁶ Orthopedic conditions were always eliminated as the source of complaints.

Comparison of Tests for Vasospasm

Landis and Gibbon showed that in normal subjects, immersion of the hands and forearms in warm water of 109.5 to 113 F. (43 to 45 C.) produced vasodilatation in the lower extremities. They found that normally the temperature of the toes rises to 89.6 F. (32 C.) within twenty-nine minutes during the immersion of the arms, when the tests are performed with controlled

* From the Department of Physical Therapy of the Albany Hospital, Albany, N. Y.

¹ Read before the Western Section of the American Congress of Physical Therapy, Los Angeles, June 15, 1939.

room temperatures. In every instance the toe temperature exceeded 88.7 F. (31.5 C.), which Morton and Scott regarded as the minimum normal response to spinal and general anesthesia, and to anesthetization of the posterior tibial nerve. Thus the immersion of the forearm in warm water is a convenient method of distinguishing between vasospasm and organic occlusion, although the authors point out that it is not always reliable. These authors cite three cases of acrocyanosis which either failed to respond at all, or gave delayed or partial response to warming of the posterior tibial nerve. They also mention one case of arteriosclerosis in which warming the forearms failed to produce a vasodilator response, but anesthetic block of the posterior tibial nerve showed that the vessels were capable of limited dilatation.

To determine for ourselves the value of the Landis-Gibbon test, ten subjects were studied, comparing the temperature rise in the toes following immersion of the arms in warm water with the rise occurring after anesthetization of the posterior tibial nerve with procain. Five of these subjects were "normal," i. e., without signs or symptoms of peripheral vascular disease. In these cases there were no significant differences in the results obtained by the two methods. In four patients having varying degrees of arteriosclerosis, no differences of diagnostic value were seen after testing by the two methods. However, the tenth subject, who complained of cold feet and hands, and was diagnosed as having acrocyanosis, showed no rise in the temperature of the toes, even after one forearm was immersed for sixty minutes in water at 110-112 F. Yet, after injection of 10 cc. of 1 per cent procain solution into the posterior tibial nerve, the toe temperature rose from 69 to 95 F. These findings confirm those of Landis and Gibbon and support the usefulness of their method of producing vasodilatation. Failure to obtain any response by this procedure should be checked by another accepted method, such as posterior tibial nerve block or spinal anesthesia.

The nine patients who showed no important differences by the Landis-Gibbon test and the posterior tibial nerve block, were tested for the vasodilating effect of ethyl alcohol. In this study, they were given one and one-half ounces of 70 per cent ethyl alcohol in a glass of orange juice, after they had been in the constant temperature room thirty minutes, or longer, to allow for spontaneous cooling of the extremities. In only one "normal" individual was there observed any significant rise in toe temperatures. In the other eight patients, including the remaining four normal persons and four with arteriosclerosis, there was a drop in toe temperature. The decrease in toe temperatures varied from 11 F. in a room temperature of 77 F. to 0 F. at a room temperature of 70 F., the usual decrease being 0 to 2 F. at a room temperature of 71 to 72 F. The initial skin temperatures were taken thirty to sixty minutes after the patients were admitted to the constant temperature room, and it may be that the smaller decreases in skin temperature represent spontaneous cooling. But the significant fact is that at these room temperatures there was no increase in toe temperature in eight out of nine persons tested and hence, no demonstrable vasodilating effect of ethyl alcohol. In each case there was, however, a rise in finger temperature of 1.5 to 2 F.

Similar experience with the use of ethyl alcohol was obtained by Horton,¹⁷ of the Mayo Clinic, who found that vasodilation in the feet occurs more readily if the subject tested is in a constant temperature room at 80 to 83 F. He used one and one-half ounces of 95 per cent alcohol, in a glass of orange juice, yet found that "in a relatively cool room vasodilation practically never occurs in the lower extremities following the administration of

alcohol." This leads me to question the practice of prescribing alcoholic beverages, in cold weather, to patients with peripheral vascular disease, and to patients who have frost-bitten toes or fingers. Further studies of the effect of alcohol on the vascular system by plethysmographic readings and temperature studies seem indicated.

Classification of Patients

Since the first pavaex treatments were given at the Albany Hospital, 246 persons have been referred for examination for possible peripheral vascular disease or to determine whether passive vascular exercises might be of value. No suction-pressure treatments were given to 60 of this number (24 per cent), either because there was no evidence of potential vasodilatation, or because this type of treatment was contraindicated. Eleven patients with peripheral arteriosclerosis were advised to have pavaex treatments, but for various reasons did not follow the suggestion. Three other patients were sent in only for examination.

The necessity for a careful and complete physical examination, including a serologic test to rule out syphilis, before advising pavaex treatments is shown by the wide variety of conditions simulating peripheral vascular diseases encountered in our experience. This ranged from peripheral neuritis to carcinomatous scars and the like. We can only speculate how much of the general disappointment in passive vascular exercises is due to inaccurate diagnoses.

We have seen five patients, who complained of severe, burning pains in their feet and legs. This pain was fairly constant; yet on examination no evidence of peripheral circulatory deficiency could be found in four, and low grade arteriosclerosis was observed in one case. Whether these were cases of erythromelalgia is not certain. The skin temperatures of these patients were normal or slightly elevated, and in some the toes and feet were a brighter pink or red than is normal. Obviously, pavaex is not suitable for such patients; and nothing we have recommended, such as elevation of the lower extremities, cold foot baths, or contrast baths, or diathermy has helped them.

As yet, we do not have a clear understanding of, or agreement upon the diagnosis of erythromelalgia. Brown¹⁸ regards four fundamental criteria as essential to the diagnosis of this disease: (a) bilateral burning pain in the extremities; (b) sharp increase of local heat in the affected parts, though the redness, flushing or congestion may vary in degree; (c) production and aggravation of the distress by heat and exercise, and (d) relief by rest, cold and elevation. These criteria might be regarded as establishing a disease entity. However, Sir Thomas Lewis¹⁹ states that: "'Erythromelalgia' is a term that should be abandoned as the name of a disease," and suggests that: "The term 'erythralgia' might be employed usefully to designate a peculiar condition of painful redness of the skin, which is common to a number of diseases." Lewis believes the painful redness is due to a local condition of the skin and is often, if not always, inflammatory.

Results of Pavaex Treatments

In considering this series of cases, only those patients who received a minimum of twenty hours of alternate suction-pressure, over a period of thirty days or less, were regarded as having had sufficient pavaex to allow for benefit from these treatments. This is only a bare minimum and in many cases is undoubtedly less than a fair minimal trial. Indeed, it is half of the usual minimal course of treatments recommended to our patients for

the relief of symptomatic complaints, but it serves as an arbitrary measure for evaluating our experience.

TABLE 1.—*Patients Given Pavaex Treatment*

	Number of Cases	Number Improved	Number Not Improved on Minimum Treatment	Percent* Improved
Arteriosclerosis obliterans with diabetes.....	30	14	9	60.9
Arteriosclerosis obliterans without diabetes.....	95	53	11	82.8
Thrombo-angiitis obliterans.....	10	5	3	62.5
Sudden arterial occlusions.....	20	10	6	66.5
Raynaud's Disease	4	4	0	100
Frozen feet	4	2	0	100
Varicose ulcers	2	2	0	100
Other conditions (Table 4).....	7	4	0	100
Totals.....	172	94	29	76.4

* Based on patients who received a minimum of adequate treatment.

One hundred seventy-two patients were given passive vascular exercise. These are divided into groups, according to their diagnosis (table 1). In determining the percentage of improvement, no consideration is given to those patients who received less than the twenty hours of treatment regarded as minimum. Thus the corrected percentage is based on the number improved, and the number who failed to improve, on the minimum treatment. It should be noted that if the minimum hours of treatment were increased, the corrected percentage of improvement would also increase. Of the total number of all groups of patients treated, 123 received the minimum hours of pavaex; and of these 94 were improved and 29 unimproved, giving a corrected percentage of improvement of 76.4.

The group of treated chronic occlusive vascular diseases (table 2) in-

TABLE 2.—*Pavaex in Chronic Occlusive Vascular Disease (135)*

DIAGNOSES	No. of Cases		Improved		Total		Not Improved		Insufficient Treatment		Sufficient Treatment		Corrected Per Cent			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Arterio-sclerosis c																
Diabetes	30	14	46.7	16	53.3	7	43.7	9	53.6	60.9	39.1	6	20.	..	..	..
Gangrene	12	2	16.7	10	83.3	5	50.	5	50.	28.6	71.4	5	41.7	..	..	..
Impending																
Gangrene	4	3	75.	1	25.	..	..	1	100	75.	25.	..	..	..	..	..
Ulceration	8	5	62.5	3	37.5	2	66.7	1	33.3	83.3	16.7	1	12.5	..	..	..
Intermitt.																
Claudication	4	2	50.	2	50.	..	..	2	100	50.	50.	..	..	..	..	..
Pain	2	2	100	..	..	..	..	..	100	..	..	..	..	..	..	..
Arterio-sclerosis s																
Diabetes	95	53	55.8	42	44.2	31	73.8	11	26.2	82.8	17.2	6	6.3	3	3.16	..
Gangrene	8	3	37.5	5	62.5	4	80.	1	20.	75.	25.	3	37.5	2	25.	..
Impending																
Gangrene	7	4	57.1	3	42.9	..	..	3	100	57.1	42.9	2	28.6	..	..	..
Ulceration	7	3	42.9	4	57.1	2	50.	2	50.	60.	40.	1	14.3	1	14.3	..
Intermitt.																
Claudication	40	24	60.	16	40.	12	75.	4	25.	85.7	14.3	..	..	..	..	..
Pain	28	17	60.7	11	39.3	11	100	..	..	100	..	..	..	..	..	..
Numb, tingling, coldness	4	1	25.	3	75.	2	66.7	1	33.3	50.	50.	..	..	..	..	..
Weakness & tiring of feet	1	1	100	..	..	..	..	..	100	..	..	..	..	..	..	..

(Concluded on next page.)

(Concluded)

TABLE 2.—*Paevex in Chronic Occlusive Vascular Disease.*

Buerger's Disease	10	5	50.	5	50.	2	40.	3	60.	62.5	37.5	1	10.	1	10.
Ulceration	3	1	33.3	2	66.7	—	—	2	100	33.3	66.7	1	33.3	1	33.3
Intermitt. Claudication	2	1	50.	1	50.	1	100	—	—	100	—	—	—	—	—
Pain	5	3	60.	2	40.	1	50.	1	50.	75.	25.	—	—	—	—
Totals	135	72	53.3	63	46.7	40	63.5	23	36.5	75.8	24.2	13	9.6	4	2.96

cludes 135 patients. Of these, 72 were regarded as improved, and 63 not improved; but of this number, 40 had less than twenty hours treatment within a period of thirty days. The corrected percentage of improvement in this entire group is 75.8. Thirteen patients (9.6 per cent) required major, and 4 patients (3 per cent) had minor amputations. The separate disease entities of this group are classified and considered as follows:

1. *Arteriosclerosis Obliterans With Diabetes.*—Thirty patients belong in this group, of which 14 were improved. For simplicity in classification and evaluation of the results, only the chief complaint, or the most important sign is listed. Patients were regarded as improved (1) when an area of superficial gangrene decreased in size and allowed for a successful minor amputation of toes or parts of toes, which otherwise would have been a major amputation; (2) when impending gangrene cleared up; (3) when ulcers became smaller in size, or healed entirely; (4) when patients with intermittent claudication were able to walk longer distances; (5) when pain, whether associated with ulceration, ischemic neuritis or trophic changes, was lessened or relieved. The corrected percentage of improvement in this group is 60.9. The poorest results were seen in 12 patients with frank gangrene. Of these only 2 improved, and 5 (41.6 per cent) required major amputations. The remaining 5 either refused amputation, or went elsewhere for treatment.

When Herrmann and Reid's first papers appeared, treatments of one-half hour each were regarded as adequate, if these were given six or seven times each day in emergencies, and three times weekly for milder symptomatic complaints. De Takats²⁹ seemed to obtain better results with daily treatments of one hour. Experience has shown that these short treatments were inadequate. At present we consider as an adequate minimum trial, for mild symptomatic complaints, a course of twenty treatments, of two hours each, given over a period of forty to sixty days. This is satisfactory only where there is no immediate possibility of amputation. In cases of gangrene, impending gangrene, or severe, painful ulceration, daily treatments totaling twelve to eighteen hours may be necessary.

2. *Arteriosclerosis Obliterans Without Diabetes.*—The ninety-five patients in this group make it the largest of our series. Of this number 53 improved. However, of the remaining 42 who showed no improvement, only 11 received the minimum treatment. The corrected percentages therefore are 82.8 improved, and 17.2 not improved. In this group all patients obtained relief from pain, and 85.7 per cent showed improvement in their intermittent claudication. Some patients whose symptoms became worse several months after the treatments had been discontinued returned for further care. Some of them obtained complete relief and did not require further treatment. The most satisfactory use of the passive vascular exercises has been found in relieving pain and in lessening intermittent claudication. In general, when there is death of tissue the results of alternate suction-

pressure are poor, and often amputation is deemed advisable before the minimum adequate treatment can be given.

Only a few of these patients were advised to stop smoking, in contrast to patients having thrombo-angiitis obliterans of whom cessation of smoking was always requested—but seldom followed. Silbert²¹ insists that before a method of treatment can be evaluated the patients must have ceased smoking for at least six months before the treatment was begun. However, if a patient shows improvement, even while smoking, it would seem that the improvement may be attributed, in part at least, to the method employed.

3. *Thrombo-angiitis obliterans (Buerger's disease).*—Fourteen patients were diagnosed as having this condition, but only 10 received treatment. Five of these improved with pavaex treatment. Of the 5 who did not improve, 3 had a minimum of treatment, thus the corrected percentage of improvement in this small group is 62.5. Although all patients in this group were advised to give up smoking, it is not believed that any did. One patient required amputation of both legs and another of one toe. Each of these was a heavy smoker and refused to stop. As is well known, there are spontaneous remissions of symptoms in Buerger's disease, and it may be that in some instances improvement was due to the natural course of the disease. However, most of these patients felt better while receiving the alternate suction-pressure and for two to three days immediately following each treatment. Whenever there was a longer interval than usual between treatments the pain returned, but the intervals between pain became longer as the treatment progressed, and by the end of a course of twenty treatments for forty hours or more, there was little or no pain.

4. *Acute Occlusions.*—The most dramatic results from passive vascular exercises are seen in the treatment of acute arterial occlusions, whether due to thrombi or emboli. No volume of statistics can be as convincing as the observed improvement of a number of patients with impending gangrene. Twenty such patients showed no palpable pulses at the level of the femoral or popliteal arteries or below, no oscillations could be recorded, and the temperature of the involved extremity was 10 F. or more, lower than its fellow (table 3). Nine of these with impending gangrene cleared up entirely and one other, in whom the foot had been slightly discolored for eight days before treatment was begun, also improved. The relief of pain is often very striking. Three patients who suffered such severe pain that morphine did not relieve them, obtained relief with pavaex treatments.

Six patients required amputation either because there was no improvement or due to spread of the impending gangrene. As has been emphasized by Reid and Herrmann, de Takats, and others, the time between the onset of the symptoms and the beginning of the treatment is a most important factor. Case 15 was seen five hours after the onset of his complaints and was expected to respond well, yet progressive femoral thrombosis rendered amputation necessary. Two others (cases 14 and 17), were treated eighteen and thirteen hours, respectively, after the onset of their occlusions, but despite intensive treatment required amputation. The other 3 patients were seen more than twenty-four hours after the beginning of their complaints, but none of these had a fair trial of treatment—two because of the advanced degree of gangrene, and one because of a heart condition which did not permit intensive treatment.

One patient (case 5), who seemed to be responding well to treatment, as shown by the relief of pain and the improved color of the skin, had his leg amputated after thirty-seven hours of treatment in ten days.

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TABLE 3.—*Acute Occlusions Treated by Paravax*

Case No.	Patient No.	Age	Diagnoses	Absent Pulsations			Onset Before Treatment	Treatment	Result and Comment
				R.D.P.	P.T.	R.D.P., P.T.			
1	2	60	Popliteal Embolus	32 hrs.	in 21½ days	17½ hrs. in 13 days	Improved: After starting to walk, claudication developed, then disappeared. Pain relieved completely.		
2	6	62	Popliteal Embolus	8 days			Improved: Pain, temp., and discoloration completely removed.		
3	31	87	Femoral Thrombus	7 hrs.	19½ hrs. in 18 days	Improved: Dramatic results: First night pain relieved; when paravax was off 20 min. Pain relieved, returned when paravax was on.			
4	55	55	Femoral Embolus	2 hrs.	100½ hrs. in 29 days	Improved: Pain relieved, color and temp. being restored.			
5	58	60	Femoral Thrombus	30 days	37 hrs. in 10 days	Improved: Pain relieved. Color and temp. restored.			
6	66	42	Femoral Thrombus	21 days	22 hrs. in 75 days	Improved: Pain relieved 20 days by phlebitis.			
7	93	35	Femoral Embolus	13 days	220 hrs. in 151 days	Improved: Pain completely relieved. Gangrene did not develop.			
8	96	63	Dorsalis Pedis Thrombus	3 days	129 hrs. in 10 days	Improved: Went home after 10 days treatment.			
9	158	23	Femoral Embolus	7 hrs.	129 hrs. in 10 days	Improved: Had complete recovery.			
10	161	76	Femoral Embolus	7 hrs.	22 hrs. in 21 days	All toes cleared.			
11	1	66	Bilateral Popliteal Aneurism	7 hrs.	119 hrs. in 19 days	Improved: Pain completely relieved; temp. and color restored. Returned to work.			
12	45	54	Femoral Thrombus	3 hrs.	119 hrs. in 19 days	Improved: Color restored. Right Foot: Improved.			
13	46	40	Brachial Thrombus	2 hrs.	27½ hrs. in 12 days	Left Leg: No change and leg was amputated.			
14	77	72	Femoral Thrombus	44 hrs.	3 hrs. in 4 days	Amputation: Heart condition did not permit.			
15	84	45	Femoral Embolus	?	1 hr. in 2 days	Amputation: Heart condition did not permit.			
16	91	76	Femoral Embolus	18 hrs.	81½ hrs. in 9 days	Amputation: Seemed hopeless from the start.			
17	129	67	Femoral Thrombus	5 hrs.	43½ hrs. in 4 days	Amputation: Seemed hopeless from the start.			
18	61	72	Femoral Thrombus	7 days	12½ hrs. in 2 days	Amputation: Gangrene developed despite intensive treatment.			
19	88	50	Femoral Embolus	13 hrs.	85½ hrs. in 8 days	Amputation: Progressive thrombosis in femoral artery.			
20	142	57	Multiple Emboli	96 hrs.	46 hrs. in 7 days	Amputation: No change in condition during 2 days.			
				5 wks.	278 hrs. in 20 days	Amputation: Patient had a fair trial. At first appeared to improve, then impending gangrene spread.			
				5 hrs.	1 hr. in 1 day	Not improved: Color of skin improving. Heart improved; Color of skin improving. Died few days later.			
						Condition limited pavaex. Died at another hospital: Received hot packs at another hospital.			
						Not improved: Received hot packs at another hospital: Caused gangrene. Died.			
						Expired: with cerebral embolus.			

Of the 3 remaining patients who did not improve, one (case 20), had one hour of treatment, then died from a cerebral embolus; another (case 18), had the signs of occlusion ninety-six hours before seeking treatment and died suddenly after forty-six hours of treatment in seven days, during which time she was showing some improvement. The third (case 19) had been treated with hot packs at another hospital, and was seen here five weeks after the onset of her trouble. This patient is a case in point of the great danger involved in applying excessive heat — dry or moist — to an extremity with a deficient blood supply. An area two inches square on the dorsum of the foot was gangrenous. Despite one hundred seventy-eight hours of treatment in twenty days, she did not improve and died after amputation at another hospital.

A study of one hundred cases of sudden arterial occlusions seen at the Mayo Clinic,²² from 1924 to 1933, before the days of passive vascular exercises, revealed that gangrene developed in 45 per cent of the patients with occlusion due to embolism, and in 50 per cent of those due to thrombosis. That age is an important prognostic factor is shown by the fact that among patients over sixty years of age gangrene developed in 73 per cent of those with embolism and in 83 per cent of those with thrombosis. In patients aged less than sixty, the figures were 32 and 42 per cent, respectively. In this study the authors state that even where sudden arterial occlusion does not lead to gangrene, the patients may be troubled with severe pain due to ischemic neuritis. These pains may persist for weeks or months, and "even when ischemic neuritis does not occur there are ordinarily some evidences of residual impairment of circulation, such as vasomotor changes, coldness, intermittent claudication, hyperesthesia and so forth." For these residual changes we have found pavaex treatments very helpful.

In our group of acute arterial occlusion, 11 patients were sixty years, or older, and among these gangrene supervened in 5, or 45 per cent. There were 9 patients less than sixty years of age, and of these gangrene developed in three, or 33 per cent. But of the 10 patients who showed improvement after having signs of impending gangrene (60 per cent), were in the higher age group. These patients were relieved of their pain due to ischemic neuritis in a few hours, or in three to four days at the latest. The skin temperatures of the involved extremities were elevated usually to nearly the same level as those of the uninvolved leg and foot. Most of them are able to go about their work as well as before the accident occurred.

Recapitulating, of this group of 20 cases (table 3) 10 improved, 6 had major amputations because of no improvement or progress of the disease process; one had a major amputation despite improvement; one showed no change and died of heart disease; one died after one treatment, death being due to cerebral embolus; one with bilateral involvement improved in one leg, but lost the other.

Although this method of treatment was not at first intended for use in any condition other than organic occlusive diseases of the arteries Herrmann and Herrmann,²³ and Shipley and Yeager²⁴ report its use in a small number of other conditions, with success. From the very first use of pavaex at the Albany Hospital, it was employed in a variety of vascular conditions, as outlined in table 4.

Four cases of Raynaud's syndrome were treated and all showed temporary symptomatic improvement. Later 3 of these submitted to periarterial stripping and received permanent relief. The fourth case received temporary relief with pavaex, but refused operation. He moved to one of the southern states and all his foot pain and discoloration cleared up without

TABLE 4.—*Miscellaneous Conditions Treated by Pavaex*

Case No.	Age	Diagnosis	Treatment	Results and Comment
1	26	Raynaud's Dis.	10 hrs. in 23 days	Improved. Gangrene cleared up. Periarterial stripping with complete relief.
2	32	Raynaud's Dis.	13 hrs. in 11 days	Improved. Ulcer began to heal and periarterial stripping done. Complete healing.
3	39	Raynaud's Dis.	14½ hrs. in 33 days	Improved. Periarterial stripping done with relief.
4	31	Raynaud's Dis.	6½ hrs. in 15 days.	Temporary relief. Refused surgery.
5	42	Frozen Feet	1 hr. in 2 days	No change. Only 2 treatments.
6	20	Frosted Feet	2 hrs. in 5 days	No change. Pain increased by pavaex and treatments discontinued.
7	14	Frozen Feet	115½ hrs. in 25 days	Improved. Ulcers formed at toe tips; then healed. Treatments begun 3 days after freezing.
8	44	Frozen Feet	30 hrs. in 12 days.	Improved. Complete healing before discharge from hospital.
9	43	None made	7 hrs. in 14 days	No change. Obviously not suited for pavaex.
10	55	Arthritis L. knee Metatarsalgia	15 hrs. in 78 days	No change. Received metatarsal pads. Pain did not clear up.
11	74	Inflammation	7½ hrs. in 20 days 2 hrs. in 3 days	Improved each time. No real vascular lack demonstrated.
12	35	Chronic Poliomyelitis	34½ hrs. in 85 days	Improved. Ulcers healed completely. Treatments interrupted for mastectomy.
13	51	Varicose Ulcers	14½ hrs. in 53 days	Improved. Ulcer healed, but leg remained boggy.
14	65	Varicose Ulcers	12 hrs. in 25 days	Improved. Ulcers were healing and were then pinch grafted.
15	31	Traumatic Ulcer	5½ hrs. in 12 days	Improved. Ulcer was healing and was then pinch grafted. Later broke down and healed after periarterial stripping.
16	33	Thrombosis Iliac vein	12 hrs. in 28 days	No change.
17	59	Diabetes Foot Abscess	8 hrs. in 4 days	Improved. After first treatment swelling decreased to normal and discoloration disappeared.

further treatment. He has since returned to this area and has been symptomless. Allen and Norman²⁵ state that the disease must have been present two years before a diagnosis can be made. We no longer use pavaex for this condition.

Three cases of frozen feet and one case of frosted feet were treated. One of these had impending gangrene of the toes; another had gangrene of the skin of several toes. Both of these patients recovered completely. The other 2, whose chief complaint was burning pain in the feet, did not improve after one hour and two hours of treatment, respectively.

Two patients with varicose ulcers, and one with a traumatic ulcer of six months duration were improved. In one case the varicose ulcer healed completely; in the other two instances the healing was aided by pinch grafts. Other cases treated are outlined in table 4 and do not require further discussion.

Difficulties and Dangers of Treatment

In my experience with pavaex treatments I have not observed any condition definitely made worse by this therapy. However, before giving treat-

ment I have always taken into consideration the known contraindications to alternate suction and pressure. In one case of arteriosclerosis obliterans with diabetes it is probable, but not certain, that pavaex treatments hastened the need for amputation.

At times, especially in patients with very thick thighs, the rubber cuff connecting the glass boot with the extremity causes venous constriction and pain. I have employed a Bier's rubber bandage, wrapped about the rubber cuff and the thigh or arm in patients with extremities of small diameter in order to make an air-tight connection between the cuff and the skin. Occasionally this procedure causes venous constriction and pain so that the patient may not tolerate the treatment for more than one-half hour at a time. On theoretic grounds, de Takats points out that the constriction of the rubber cuff "favors venous stagnation and may predispose to venous thrombosis," but he has not observed any such effects, and neither have we.

Prolonged and frequent treatments, as in the acute occlusions, will occasionally produce soreness in the heels of the treated legs, despite the use of several layers of cotton and gauze pads for protection against friction. This is especially a problem for patients with ulcers near or on the heels. If cotton and gauze are shaped in the form of a doughnut, the heel placed into its hole, and then bandaged in place to keep the foot from slipping off, prolonged treatment may be taken with greater comfort.

Summary and Conclusions

1. Experimental studies are presented corroborating the work of Landis and Gibbon on the production of vasodilatation in the lower extremities in response to immersion of the forearms in warm water. This procedure provides a simple method of measuring the degree of vasospasm or vascular occlusion in the extremities.

2. The reputed vasodilating effect of ethyl alcohol usually does not occur in the lower extremities which have been allowed to cool spontaneously in a constant temperature room at 71 to 73 F.

3. Upon examination of 246 patients, 60, or 24 per cent, were found unsuitable for pavaex treatments. These patients did not receive passive vascular exercise either because of specific contraindications or because they did not have peripheral arterial deficiency. Accurate diagnosis of the cause of symptoms in the extremities must always be made before suction-pressure therapy is advised, in order that the patients may not be disappointed and a useful treatment fall into disrepute.

4. Even where a definite diagnosis of peripheral arterial disease is made there can be no prediction before treatment as to whether any one patient will be benefited. One hundred twenty-three patients of all classes of peripheral vascular disease, received the minimum of twenty hours of treatment used as the basis of evaluating the results. Of these, 76.4 per cent were improved.

5. Passive vascular exercise is not a cure-all and must be used in conjunction with other accepted forms of treatment to obtain the best results. In only one case have we seen any possible harmful effects of suction and pressure therapy.

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. . . EDITORIALS . . .

SHORT WAVE DIATHERMY AND HYPERTENSION

Much has been written on the nature and treatment of hypertension, particularly of that type not associated with organic disturbances of the cardio-renal apparatus and therefore commonly spoken of as essential hypertension. In spite of considerable research devoted to this problem the exact nature and cause of this affection still remain obscure. Naturally there can be no talk of any rational treatment without a known etiologic factor, so that all therapeutic efforts must of necessity be rather empiric in method and application. The only clue to any kind of treatment lies in the recognition that both the local and the general types of essential hypertension show in the majority of cases a state of vaso-constriction of the arterioles. Drugs and organic products have been tried with temporary effects and the same may be said of physical measures. It will be recalled that when conventional diathermy held the stage, its application in the form of both autoconduction and condensation was a widely used method and virtually abandoned because of its ephemeral effect.

It was nevertheless recognized that the quality of diathermy to produce local and systemic hyperemia was a factor which justified its experimental use, at least in the so-called benign types of hyperpiesis. A method which seems to have been fairly effective even with the classic type of diathermy was the direct application of the current to the carotid sinus. This local application was applied also to the region of the heart. Thus Pizarro and Levisman¹ made use of plain electrodes, the active and smaller one being placed to the carotid and the dispersive over the pectoral region, the applications of which being made for ten minutes on alternate days and later increased by five minutes until sessions of thirty minutes were attained. These authors claim to have freed a comparatively large number of patients from headache and vertigo and to have restored them to a state of well-being. This report is particularly noteworthy because it frankly admits failure in ten out of forty patients, in whom the symptoms were not relieved and the pressure or blood tension remained unaffected. Theoretically this treatment is based on the assumption that essential hypertension is caused by an effect on the sympathetic system and that the dilatation of the blood vessels produced by the diathermy to the carotid sinus favorably influences the blood pressure and its concomitant symptoms. The authors stress the fact that even in the cases of failure the treatment produced no harm.

More recently, however, the advantages of short wave diathermy over the conventional form have been demonstrated by a number of French workers for the same purpose, and what is more striking, conditions associated with arteriosclerosis. Not a few of these clinicians have even gone farther, in that they tried the application of short wave diathermy to the carotid sinus in types of hypertension ascribable to nephrotic changes, albeit with less favorable results than in the essential type. In a comprehensive review of these efforts, Delachaux and Schneider² analyze the results in thirty-three patients, fifteen of whom had been materially benefited by this form of radiation. That these cases were not altogether mild ones is evidenced by the circumstance that all had taken various forms of medication for a prolonged period without any relief. The authors properly point out that this treatment is contraindicated in chronic nephritis, asystole and thyroid disturbances, but with these exceptions recom-

mend that it be given a fair trial even in generalized arteriosclerosis associated with hypertension. Any unfavorable reactions in a given case will of course suggest interruption of the treatment.

Similar observations have been made by American workers, so that within the limitations imposed the method merits wide employment in private practice which can be carried out as an ambulatory procedure. It is hardly necessary to point out that any known factor likely to produce or aggravate the high blood pressure should also receive full attention. Though no one will hazard to regard short wave application to the carotid sinus as a specific measure, it appears to be from the experiences gained so far a very promising adjuvant which merits study and clinical observation. In this respect it would be advisable to observe combinations with other forms of therapy because of the likelihood of producing more favorable effects.

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ELECTRICAL SHOCK THERAPY OF PSYCHOSES

It is well known that intense shock has proved a therapeutic factor in the management of a number of mental diseases. This procedure was clinically established through a pure accident which focussed the attention of psychiatrists to shock as a remedy especially in schizophrenia. It is a matter of record that an insane patient had accidentally come in contact with a powerful alternating current which produced intense convulsions and that after being separated from the current he showed a dramatic improvement in his mental condition. This single observation naturally suggested pronounced shock as a therapeutic measure in psychoses, but the hazard incident to the application of electrical currents brought about a resort to chemicals of which cardiazol and similar preparations are utilized by psychiatrists to this very day. This method of shock therapy, however, is not devoid of certain risks and even of fatalities. The literature on this subject contains quite a number of reports of fractures of the spine and femora, dislocations of the jaws, auricular fibrillation and heart block. Other reports pertain to peripheral circulatory disturbances, for which reason attempts have been made to substitute triazol, which while safer in some respects presents a number of disadvantages. It seems that this form of shock therapy has another serious drawback in that many patients develop extreme fear and apprehension to such an extent that certain workers felt impelled to resort to general anesthesia. Finally this treatment has been followed in many instances by somatic and psychomotoric disturbances which left the patients in worse shape than they were before the institution of biochemical shock. As was already pointed out, there is no dearth of published accounts of death following this form of therapy.

Under the circumstances it is highly important to know that recently efforts have been made to return to electrical shock measures by a method which is apparently devoid of the risks and dangers incident to chemotherapy. This method is credited to Cerletti and Bini,¹ Bini^{2,3} of Rome, and has since been improved by Kalinowsky⁴ and Shepley and McGregor⁵ of England. A scientific basis for the new method of electrical shock treatment has been provided by Cerletti and Bini through histologic studies of the cerebral cortex of dogs after the application of voltages much higher than is needed to

produce a convulsion. These experiments have subjected the animals to several convulsions before examining the brain which was found to be entirely free of the pathologic changes commonly seen in experimental studies with cardiazol or those following insulin coma, in which hemorrhages and certain cell changes invariably took place. The special instrument patented by Bini has been found to be somewhat unsatisfactory for clinical work and has been modified by Shepley and McGregor to provide an electrical time switch, a ballistic method of measuring the milliamperes-seconds and an appliance for compensating any fluctuation in the line current. These modifications appear to be important because the treatment presupposes perfect control of intensity and time-dosage, to correspond to the head resistance of the patient. The British workers make use of a voltage ranging between 90 and 145 with a time setting of 0.1 to 0.2 of a second. The passage of such a current produces a more or less pronounced convulsion approaching in many instances an epileptic seizure and averaging 50 seconds in duration. It then requires but a few minutes for the patient to regain consciousness and to converse in a somewhat drowsy fashion. In no instance have they observed the psychomotor excitement often seen after the administration of cardiazol. In the milder forms of this reaction some patients have complained of only a slight headache.

Of particular interest is the fact that patients subjected to electrical shock cannot possibly develop any fear or apprehension owing to the fact that loss of consciousness takes place instantaneously, for which reason alone if for no other this method promises to become one of choice in the very near future. Technically the application of the current which is made to the head at the junction of the temporal and parietal bones, is relatively simple. The greatest obstacle lies in the need for specially equipped apparatus facilitating the determination of the head resistance by direct reading on a potentiometer. After such determination one should have available a properly controlled current for the indicated intensity and duration required for the degree of shock in individual cases.

The results already reported show that this method is too valuable and yet too complicated to be employed without careful preparatory study both experimentally and clinically. It is clear from what has been said that this procedure should be carried out only in hospitals equipped for such work and under special medical supervision. It may not be amiss to point out that while the apparatus devised by Shepley and McGregor would greatly facilitate the first experimental investigations, its absence in this country should not deter qualified students from carrying on research with apparatus of their own design for the purpose of confirming the superior results claimed for electrical shock treatment of various forms of psychoses.

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SCIENCE, NEWS, COMMENTS

New York Physical Therapy Society

A closed meeting of the New York Physical Therapy Society will be held on Wednesday, February 7, at 8:30 P.M., at Dr. Gustav Bucky's residence, 5 East 76th Street, New York City, at which the following program will be presented:

1. Scientific Session — Paper of the Evening, On Grenz Rays and Their Position in the Physical Therapy Field — *Gustav Bucky, M.D.* Discussion opened by Mr. Myron Schwarzchild.

2. Executive Session.

Lewis J. Silvers, M.D.,
President.

Madge C. L. McGuinness,
Secretary.

Section on Physical Therapy Medical Society of the County of Kings

The next regular meeting of the Section on Physical Therapy of the Medical Society of the County of Kings will be held in the Kings County Medical Society building, 1313 Bedford Ave., Brooklyn, N. Y., Thursday, March 14, 1940, 8:30 P.M. sharp. The following program will be presented as a Symposium on Scoliosis:

1. Orthopedic Aspects — *Jacques C. Rushmore, M.D.*, Orthopedic Surgeon, Long Island College Hospital.

2. Medical Aspects — *Thomas J. McGoldrick, M.D.*, Medical Director St. Peters, Attend. Physician St. Anthony's Hospitals.

3. Physical Therapy Aspects — *Jerome Weiss, M.D.*, Director Physical Therapy Diseases of Joints N. Y., Asst. Orthopedic Surgeon, Long Island College Hospital.

New Committee on Physical Therapy in State of Indiana

It is gratifying to announce that a special committee on physical therapy has been appointed by the State Medical Association of Indiana. The appointees to serve on this committee are:

E. L. Libbert, Chairman, Lawrenceburg; *H. W. Smelser*, Connersville; *E. N. Kime*, Indianapolis; *B. L. Harrison*, New Castle; *N. H. Prentiss*, Fort Wayne. In a communication recently received from Dr. Libbert, it is pointed out that the work of this Committee has been planned along the lines of education of the general medical profession in the State of Indiana with reference to proper physical therapeutic procedures. The Committee is anxious to have the support of the American Congress of Physical Therapy in its efforts.

Is This A War Emergency?

The headquarters of the American Registry of Physical Therapy Technicians is informed that the American Red Cross National Office in Washington is preparing for emergency measures that contemplate an approaching state of war with unknown or unnamed powers. To the Registrar, Marion Smith, has come a letter from Washington which says much between the written line. The medical adviser of the Red Cross in part informs Miss Smith that —

... The American National Red Cross has now been definitely authorized to proceed with the enrollment of physical therapy technicians to be available for service with the Army and Navy Medical Corps in the event of emergency, and we are ready to work out with you a practical plan of procedure.

... In the event of emergency, women technologists will be employed as civilians in the Army. The Navy prefers present peace-time enlistment in the Naval Reserve of men only.

The general qualifications will be as follows —

1. Citizens of the United States.
2. Between the ages of 21 and 45 years — Navy 18-35.
3. Physically qualified. All applicants must submit a report of physical examination with the application for enrollment. Male applicants must meet the physical standards required for enlistment in the Navy and female applicants must meet those for appointment in the Army Nurse Corps.
4. All female applicants must be unmarried.
5. All applicants must express a willingness to serve as a technologist in time of national emergency. . .

One wonders whether this communication is a hint that Mars is again to bestride the World, or whether in anticipation of tragic eventualities, the Washington office is making preparations for an emergency that all of us pray never will come. If it is war, let us be ready. And if peace continues, it is still a good bet to be prepared.

1940 Officers New York Physical Therapy Society

At its annual meeting, held January 3, the New York Physical Therapy Society elected the following officers:

Dr. Lewis J. Silvers, President; Dr. Frederick E. Bauer, Vice-President; Dr. Richard Kovacs, Treasurer; Dr. Madge C. L. McGuinness, Secretary. The Executive Committee: Drs. Farel Jouard, Chairman; Charles G. Buckmaster, David Derow, Harold Niefeld, and Sidney Licht.

Eastern Section Meeting

The Eastern Section of the American Congress of Physical Therapy will hold its 1940 Spring Meeting on Wednesday, April 10th at Trenton, New Jersey in conjunction with the Mercer County Medical Society, the Pennsylvania Physical Therapy Association and the New York Physical Therapy Society. The afternoon meeting will be held at Mercer Hospital and will be followed by dinner at the Trenton Country Club. At this session plans for the formation of a New Jersey Physical Therapy Society will be discussed. The evening session will be held at the Trenton Country Club.

The officers of the Eastern Section are Dr. B. S. Troedsson of New York City, Chairman, and Dr. A. A. Martucci of Abington, Pennsylvania, Secretary.

"Father" of Nylon Receives Prized Medal of Chemists

The chemist who initiated the research of making big molecules out of little ones that led to the discovery of nylon, remarkable organic material out of which chemistry can make anything from sheer silk-like stockings to toothbrush bristles and fishline leaders, was awarded one of science's highest honors: the Perkin Medal of the American Section of the Society of Chemical Industry.

The man is Dr. C. M. A. Stine, vice-president in charge of research, of E. I. du Pont de Nemours & Company of Wilmington, Del. In his address following the medal presentation Dr. Stine traced the rise of America's great organic chemical industry of today from its virtual birth at the time of the World War in 1914.

Directly or indirectly from the results of intensive research in organic chemicals have come the following advances: Modern plastics, motion picture film using synthetic camphor, medicinal chemicals like sulfanilamide and sulfapyridine, superior dyes, improved cheap and safe refrigerant fluids like Freon, a vast improvement in the wear of automobile tires, the development of synthetic rubber, safety glass, tougher and more oily oils and lubricants for motor cars, superior gasolines and fuels, better and safer explosives, synthetic urea for fertilizer for agriculture, and the new plant hormones and vitamins.

Contrary to popular belief, American chemical industry was large prior to the World War, but mainly in the inorganic chemical field, Dr. Stine said. As early as 1865 its products had a valuation of some \$60,000,000. In 1910 the United States produced three times as much sulfuric acid as Germany and twice the amount of alkalies made in England.

In organic chemicals, however, the United States was sadly lacking at the start of the war. The great industry which has been created since that time, in this field, represents an enormous investment of American money and American brains in research, Dr. Stine continued. He revealed that in the case of the du Pont concern alone, \$40,000,000 was invested in research before a cent of profit was realized.

Dr. Stine challenged those who maintain that present national and international ills are the result of too much scientific development.

These people overlook, he said, "the horrible wars that have been waged all down the years when there was no science as we know it today. They overlook or wilfully ignore the well recognized fact that the lust for power by one man, or a small group of men, leads all too frequently to that great social and economic disaster called war. Until indoctrinated race antipathies and hatreds, envy, and greed for power are eliminated from human nature through spiritual regeneration, we shall have no solution of this fatal disease which afflicts humanity. Science, though it is able to confer the richest blessings upon mankind, is not able to change the heart of man and insure that the great increases in scientific knowledge will be beneficially applied. But while this is unquestionably true, I nevertheless hold that the great contribution which the development of the organic chemical industry has made to the self-sufficiency of this country is a definite contribution toward the maintenance of peace." — *Science News Letter*.

Physicians' Committee Formed for Medical Service Extension

Organization of the National Physicians' Committee for the Extension of Medical Service is announced by the *Journal of the American Medical Association* (Dec. 2), which describes its work as "of the nature of public relations activities."

Objectives of the new organization are said to be covered in the statement that it is "a nonprofit, non-political organization for maintaining ethical and scientific standards and extending medical service to all the people . . . and for . . . cooperating with lay and medical institutions and groups, interested in the preservation of national health, to make more generally known the achievements and to safeguard the independence of American medicine."

The organization, officially launched in Chicago on Nov. 18, the day after the American Medical Association board of trustees held its fall meeting, is headed by an executive board which includes past-presidents and members of the board of trustees of the A. M. A.

"The organization is not, however, officially connected with the American Medical Association itself," states an editorial note in the *A. M. A. Journal*.

"Information elicited from the officials of the National Physicians' Committee," the *Journal* editor continues, "indicates that this group has been organized voluntarily to carry on the education of the public regarding the extension of medical service and preventive medicine. Their work is of the nature of public relations activities."

"The National Physicians' Committee," it is further pointed out, "is in a position to accept contributions from industrial and other organizations in order to aid this campaign. The American Medical Association itself has not in the past and does not now accept such contributions."

Among reasons for forming the new organization, stated by the management committee, are the following:

"If the ethical and scientific standards are to be maintained, the independence of American medicine preserved and the public interest best served, American physicians must:

"1. Make possible the providing of medical service to the indigent and those in the low income groups, and insure the most widespread distribution of the most effective methods and equipment in medicine and surgery.

"2. Assume the responsibility of countering destructive propaganda by familiarizing the public with the facts in connection with the methods and the achievements of American medicine."

Officers of the new organization are: Dr. Edward H. Cary, Dallas, Texas, chairman; Dr. Austin A. Hayden, Chicago, secretary, and Dr. N. S. Davis III, Chicago, treasurer. Other members of the executive board are: Dr. Irvin Abell, Louisville, Ky.; Dr. F. F. Borzell, Philadelphia; Dr. William E. Braasch, Rochester, Minn.; Dr. John A. Hartwell, New York; Dr. Roger I. Lee, Boston; Dr. Alphonse McMahon, St. Louis; Dr. E. H. Skinner, Kansas City, Mo., and Dr. Charles B. Wright, Minneapolis. — *Science News Letter*.

Electricity Through Head Is New Shock Treatment

Use of electric shock treatment for mentally sick patients is announced to the medical world by Dr. Lothar Kalinowsky, of Rome, through a report to the medical journal, *Lancet*.

The treatment is like the now widely-used insulin and metrazol shock treatments. Instead of injecting either of these shock-inducing drugs, an electric current is passed through the patient's head to induce the fits, or convulsions, which restore the patient to sanity, for a time at least.

The electric shock treatment is said to be much easier on the patient, and also on the nurses and attendants, than the metrazol or cardiazol shock treatments. Nor is there any danger from the amount of current used to induce the fits.

"Several thousand fits have been produced on some hundred patients, partly treated in the Rome clinic and partly reported from other institutions, without any accident whatever," Dr. Kalinowsky states in his report of the electric convolution method.

The number of patients treated is still too small and the time since treatment is too short to allow definite conclusions as to the curative value of this method, he says.

"According to information given by several institutions it can only be said," Dr. Kalinowsky reports, "that the number of recovered and improved cases of schizophrenia corresponds at least to that of the remissions of cases which, in the same clinics, were treated with cardiazol (metrazol)."

All the disagreeable sensations patients complain of with metrazol treatment are said to be missing with the electric shock method. The patient al-

ways loses consciousness and awakens slowly, with no memory of the experience. No fractures, dislocations or ruptured muscles have ever been seen, though Dr. Kalinowsky admits that they could occur.

Electrodes are put on both sides of the patient's forehead, animal studies having shown that the temples are the best place for the treatment. Currents of 70 to 110 volts and 300 to 600 milliamperes are generally needed to produce fits. The shock is given for one-tenth of a second. — *Science News Letter*.

Discovery Refutes Report of Difference in Cancer Cells

The old idea that only "right-handed" amino acids occur in the living, healthy body, and the new idea that "left-handed" forms of these chemicals are indicators of cancer, have been refuted in the latest of Uncle Sam's researches upon disease.

This revolutionary chemical discovery has just been made by Dr. J. M. Johnson, biochemist at the National Cancer Institute, and by Dr. Dean Burk, of the National Cancer Institute, in collaboration with Drs. Fritz Lipmann, Otto K. Behrens and Elvin A. Kabat at Cornell University Medical College, New York City.

The discovery refutes the widely hailed finding of a fundamental chemical difference between cancer and normal tissue. This finding was first announced by Prof. F. Kögl and Dr. H. Erxleben, of the University of Utrecht, and other scientists have since reported finding the same difference.

The difference was believed to lie mainly in the kind of glutamic acid existing in cancer tissue. Glutamic acid is one of the amino acids which are building blocks for tissue protein in the body. In cancer tissue, glutamic acid occurred in a so-called left-handed form, Drs. Kögl and Erxleben reported. This means that it could turn a beam of polarized light to the left.

Chemists ever since the time of Emil Fischer, the great German scientist who at the close of the last century discovered amino acids like glutamic acid, have taken it for granted that the glutamic acid occurring in nature was a right-handed acid, turning the beam of polarized light to the right, although the unnatural forms of other amino acids had been prepared in the laboratory. So the discovery by Drs. Kögl and Erxleben was hailed as opening the way to a chemical attack on the great killer, cancer.

Using the method of Drs. Kögl and Erxleben, Dr. Johnson extracted glutamic acid crystals from a rat cancer, from the same rat's liver, and from the liver of a healthy animal and had no cancer. He examined the crystals and, unlike Drs. Kögl and Erxleben, found the natural form in the first crop of crystals from both cancer tissue and normal tissue.

"Go back and examine the mother liquor," his chief, Prof. Carl Voegtl, director of the National Cancer Institute, told him.

The mother liquor is the material that was left after glutamic acid had crystallized out. A little

glutamic acid was apparently still present in this liquor, however. Dr. Johnson discovered in this mother liquor, from both normal and cancer tissues, not only the natural glutamic acid, but the unnatural form of it.

Dr. Burk and associates, working in the biochemical laboratory of Prof. Vincent du Vigneaud at Cornell, used another method for observing unnatural amino acids in cancer and in normal tissue. They used an enzyme which is specific for and only acts on the unnatural, left-handed forms of amino acids. When this enzyme is added to digested cancer or normal cells in the test tube, any unnatural amino acids present are changed by the oxygen of the air into other chemicals, but the natural forms are not touched. Analyses showed that in all cancer and normal tissues examined there were the same small amounts of unnatural amino acids attacked by the enzyme.

Discovery that glutamic acid and other amino acids exist partly in their unnatural form opens the way for new lines of chemical research, although it shows that malignancy, or cancer, is not characterized by the presence of amino acids of unnatural form. — *Science News Letter*.

Neuropsychiatric Institute Proposed by Surgeon General

Mental and nervous diseases which doom their victims to a life from which death is a welcome release are scheduled for attack on a nationwide scale by the plans of the nation's leader in the fight for health, Surgeon General Thomas Parran of the U. S. Public Health Service.

Spearhead of the attack would be the National Neuropsychiatric Institute which Surgeon General Parran proposed in his annual report transmitted to Congress.

This Neuropsychiatric Institute would be modeled after the National Cancer Institute, where a staff of trained scientists are now searching for knowledge leading to methods of controlling cancer.

Mental and nervous diseases and epilepsy together represent the largest unsolved problem in medicine, Surgeon General Parran stated in his report recommending that the nation build a National Neuropsychiatric Institute.

Hospitals caring for mental disease have on their books more than 500,000 patients and more than 117,000 additional patients are in hospitals for mental defectives and epileptics. The aging of our population will tremendously increase the total number of sufferers from mental disease.

"By 1980 it is predicted that we shall have one-half the people under 19 years of age we now have, and twice as many over the age of 65," Surgeon General Parran pointed out.

"The incidence of mental disease in the age group over 65 years is 10 times what it is in the group of 19 years and under. A little mathematics will show how much more mental disease we shall have then than now. We must start now," he declared, "to work out methods for preventing mental disease to help avoid such a load in the future."

"Recent developments showing the influence of certain vitamins, such as nicotinic acid, in relieving cases of insanity not heretofore recognized as being of dietary origin open many possibilities for further research not only of accessory food factors but of other phases of body metabolism, such as hormones.

"The impression is growing among psychiatrists that constitutional and metabolic factors may play a role in forms of insanity heretofore thought of as being of psychic origin," he continued.

The effects of insulin shock treatment now used in one form of mental disease, schizophrenia, which are like "taking the veil from the patient's eyes, transporting him from a vegetable state to an apparently normal one for a time," cause a great disturbance of body metabolism, he pointed out. All these factors indicate the need for physiological research on mental and nervous disorders.

The proposed Neuropsychiatric Institute would be built on the present site of the New York Marine Hospital, giving the staff access to patients and to the library facilities of the metropolis, and the advantage of working under the "stimulating influence of extensive activities and informed personnel in the nervous and mental disease field." The plans call for 350,000 cubic feet of laboratory space for fundamental research and access to 200 patients for clinical study. It is also suggested that the Institute should have funds to allot to competent groups throughout the country for research on the problem of nervous and mental disease and epilepsy, and that a national advisory council, similar to the National Advisory Cancer Council, should be established.

The idea for the Neuropsychiatric Institute has been warmly approved by authorities in the field, it is stated. Although millions of dollars are being spent each year for the care and treatment of the mentally sick, very little is being spent for fundamental research which might lead to a measurable control of such sickness through discoveries pointing to effective measures of prevention and cure. — *Science News Letter*.

Sulfanilamide in Oil

Sulfanilamide and related chemical remedies for streptococcus and other germ diseases are more effective when given in oil than when given, as is usually done, in water or gum arabic, Dr. W. Harry Feinstone of the American Cyanamid Company reported.

The chemicals are absorbed more readily when given in oil, he found, and the concentration in the patient's blood remains at a curative level for longer periods.

New chemical derivatives of sulfanilamide, more active in mouse streptococcus infections than sulfanilamide, and capable of acting directly on the germs without first having to be broken down chemically in the body, were announced by Dr. Feinstone. These new chemicals, he said, were made by Drs. M. L. Crossley, E. H. Northey and M. E. Hultquist, of the Calco division of the American Cyanamid Company. — *Science News Letter*.

Federal Health Service Has New Vaccine

A new vaccine for protection against a new and possibly widespread feverish ailment spread by ticks is ready for its first trials on human volunteers, the U. S. Public Health Service announces.

The new vaccine, successful in guinea pig trials, was prepared by Dr. Herald E. Cox and E. John Bell, of the Rocky Mountain Laboratory of the National Institute of Health at Hamilton, Mont. It was made from germs from infected ticks and also from the same kind of germs grown on developing chick eggs.

A member of the Washington headquarters staff of the National Institute of Health was the first recognized human case of the new disease, which has been named Rickettsia diaporica. He contracted the disease while observing research on it during a visit to the Hamilton laboratories, and recovered after about one month's illness characterized by mild fever with chills, recurrent sweating and tender finger joints.

The ease with which the infection was picked up in the laboratory plus the fact that the infection occurs naturally in ticks suggests that there may have been other human cases. The disease is very similar to if not the same as the "Q" fever of Australia. The fact that two such similar diseases exist at points so geographically far apart leads health authorities to believe that other cases must be occurring in both countries and probably in many countries between here and Australia. — *Science News Letter*.

"Splint Bank" Prevents Crippling From Paralysis

A "Splint Bank" which promises to reduce the number of permanent cripples among future victims of infantile paralysis has been established by the National Foundation for Infantile Paralysis.

How the staff of this new kind of bank, themselves victims of infantile paralysis, worked three shifts a day and Sundays to handle a "run" on the bank during the Buffalo infantile paralysis epidemic last summer was told by Dr. George E. Bennett, Johns Hopkins University School of Medicine, at a dinner given by the National Foundation in honor of Mrs. Franklin D. Roosevelt and the women leaders in the 1940 Fight Infantile Paralysis Campaign.

Splints that hold the muscles immovable in a neutral position prevent deformities from contracture or overstretching of any of the muscles involved in infantile paralysis, Dr. Bennett explained. The splints also make the patient more comfortable and hasten recovery of paralyzed muscles. Best results are obtained when they are applied early, but when an epidemic of the disease strikes a community, not enough splints may be available to take care of all the patients.

Such a situation, occurring in Ontario, Canada, three years ago, led to the founding of the splint bank. During this Canadian epidemic the staff of the Hospital for Sick Children of Toronto de-

veloped a type of splint "as near ideal as could be produced and yet simple." The splints are so standardized that the doctor needs only to measure his patient and splints of the proper size can be supplied from stock.

A stock of such splints, made with funds supplied by the National Foundation for Infantile Paralysis, has been deposited in the "splint bank," located in the brace shop of the Maryland League for Crippled Children at Baltimore. The bank had 250 splints on hand when the epidemic broke in Buffalo. But this number was insufficient to supply the needs of infantile paralysis victims in that city. So, working three shifts a day and Sundays, for a month and a half, recovered infantile paralysis patients made enough more so that a total of 750 splints could be sent out, 547 to Buffalo and the rest elsewhere.

Branch splint banks throughout the United States are now planned, and it is hoped, Dr. Bennett said, "that before 1940 passes no child or adult stricken with infantile paralysis need wait for proper early splinting." — *Science News Letter*.

Q and R Factors in Equations Betray Coming of Death

Gray hair and wrinkled skin are not as satisfactory signs of old age and approaching death as Q and R. These letters are symbols of new equations devised by Dr. Henry E. Simms, College of Physicians and Surgeons, Columbia University, for shedding light on the aging processes. (Science, Jan. 5.)

We do not grow old as a result of a random accumulation of degenerative changes, Dr. Simms' equations show, thus upsetting the present theory of the aging process.

"It is perhaps correct to say that there is an accumulation of degenerative changes," Dr. Simms states, "but that the process follows a definite mechanism such that the rate of change at any age depends upon the amount of accumulated change. Why this mechanism should be followed remains to be determined."

Q and R are functions which control the death rate after the age of 30 years. Q changes with age. There are indications, Dr. Simms states, that the change in Q affects mortality by increasing the death rate when disease is present, rather than by increasing the tendency to become diseased.

Changes in R may account for the faster increase in death probability of diseases of the blood vessels (heart and artery diseases) over the increase in death probability of certain infectious, digestive and nervous diseases. The nature of this R function is unknown, but Dr. Simms suggests that it may be some property of the blood vessel system such as arterial distensibility or capillary permeability.

A statistical correlation between senile debility and senile death rate has been found by Dr. Simms' mathematical studies. This suggests, he says, that the progressive debility in old age is caused by the same Q and R functions which control the death rate. — *Science News Letter*.

BOOK REVIEWS

PHYSIOTHERAPY IN MEDICAL PRACTICE. By *Hugh Morris*, M.D., D.M.R.E., Radiologist, Manchester Corporation Hospital Services; Examiner in Electrotherapy to the Chartered Society of Massage; Lecturer in Electrotherapy, Schools of Massage, Salford Royal and Devonshire Royal Hospitals, etc. Cloth. Pp. 276 with 102 illustrations. Price, \$4.50. Baltimore: A William Wood Book. The Williams & Wilkins Company, 1939.

The author's reputation as a radiologist, examiner and lecturer of electrotherapy suggests his ability to discuss the theme of "Physiotherapy in Medical Practice" in a lucid, concise and informative manner for the benefit of the medical profession who have in the past left the choice of this form of treatment to a masseuse or her counterpart. Morris has attempted to abridge the detail associated with the manifold divisions of theory and practice of physical procedures by providing the reader with a terse yet inclusive exposition of the various methods used in this discipline and guiding the novitiate through the technical and theoretic problems to a comprehension of the purposes and end results obtained by procedures as established as they are often misunderstood. The volume in the short space of 276 pages and 22 chapters includes some practical discussions of the nature and clinical value of low tension currents (galvanic, faradic, sinusoidal), the use of hydroelectric baths; diagnosis of muscle and nerve lesions and their treatment. The author reviews and mentions the indications of the much misunderstood but valued static current, the much under-rated uses and often the abuses associated with the practice of high frequency current, conventional and short wave diathermy. In the chapter pertaining to short wave or ultradiathermy the author appears to be rather sentimentally influenced in his opinions by several of his associates, whose role in this new field of thermotherapy has been more discursive than concrete. Any attempt to review this subject within the space of the few pages herein devoted to its discussion is an injustice to one of the most important of the recent contributions in this field. One would rather have expected a greater abridgement of the chapters pertaining to the exposition of conventional diathermy in order that the discussions on short wave therapy and that of electrosurgery be expanded to the proportion and balance deserving of their importance. One feels that much could have been said that was omitted, and that these sections should have occupied a place of importance equal to that devoted to radiant light and phototherapy. One cannot, however, leave with the reader the impression that the work is lacking in merit. Indeed, with the exception of the criticism raised, the work deserves warm praise for a terse and lucid

review of physical therapy in medical practice. The book is recommended as a splendid elementary text on the subject.

FUNCTIONAL DISORDERS OF THE FOOT. THEIR DIAGNOSIS AND TREATMENT. By *Frank D. Dickson*, M.D., F.A.C.S., Orthopedic Surgeon, St. Luke's, Kansas City General, and Wheatley Hospitals, Kansas City, Missouri; Providence Hospital, Kansas City, Kansas; and *Rex L. Dively*, A.B., M.D., F.A.C.S., Orthopedic Surgeon, St. Luke's, Kansas City General, Research, and Wheatley Hospitals, Kansas City, Missouri; Providence Hospital, Kansas City, Kansas. Cloth. Pp. 305. Price, \$5.00. Philadelphia: J. B. Lippincott Company, 1939.

Though this book has evidently been prepared for the general medical profession the title does not do full justice to the contents, for while the authors stress such affections of the foot that cause discomfort and functional disturbances they consider pathologic processes of an organic nature. The authors are to be felicitated in having avoided any discussion of fractures, which after all belong to the domain of general surgery. The text which has been written in a pleasing style is well organized in 18 sequential chapters. It opens with the evolutionary development of the human foot, takes up its anatomy and physiology, after which fundamentals the authors present the primary causes of foot imbalance, methods of examination, the foot of childhood and its imbalance. The following chapters are devoted to the ills of adults with regard to foot imbalance, hallux, affections of the nails and of the skin, of the tarsal and metatarsal bones, heel and the constitutional diseases affecting the feet. Chapters are given over to a lucid discussion of foot apparel, strapping and exercises of the feet. The treatment advised in the individual affections are standard and are explained on a rational basis. The chapter on exercises describes seven procedures with good photographic illustrations showing the various maneuvers, which the authors recommend to carry out twice daily. Physical therapy apart from exercises is given little more than barest mention, such for example that "hot and cold contrast baths and massage may be used to improve circulation, relieve muscle spasm, and build up muscle tone." In spite of this shortcoming physical therapists will find much of value pertaining to the diagnosis and corrective treatment by appliances and proper footwear, so that there will be a better appreciation of their rationale in the disturbances which do not require operative intervention. The book concludes with a fairly exhaustive bibliography and an index. More than 200 well executed illustrations enhance the text. Print, paper and binding leave nothing to be desired in this valuable contribution to orthopedics.

NUTRITION AND DIET IN HEALTH AND DISEASE. By *James S. McLester*, M.D., Professor of Medicine, University of Alabama, Birmingham, Alabama. Third Edition, entirely rewritten. Cloth. Pp. 838. Price, \$8.00. Philadelphia: W. B. Saunders Company, 1939.

This completely rewritten third edition of one of the most comprehensive reviews of the problem of nutrition in relation to health and disease will arouse both the enthusiasm and appreciation of the medical profession. The data incorporated in this text impresses one with the fact that the author critically surveyed the problem from every practical viewpoint and organized his material for the benefit of both the profession and the patient. This was no small task because the concepts of nutrition have not only undergone profound changes with the increasing prescription of diet as part of health management but also because the voluminous material contributed in this field has necessitated critical selection in order to orient the profession of the physiologic influences of certain food values of importance in the regulation of a special or general dietary regime. While the present edition has been completely renovated it retains all the basic facts that made this work the choice of most conservative practitioners. In the present volume one observes an addition of two new chapters from two authoritative collaborators. A chapter on infant feeding has been contributed by Dr. P. C. Jeans, and one on the feeding of the surgical patient by Dr. Dean Lewis. The former concisely presents the various views on breast feeding, on artificial feeding of infants, a review of edible infant foods and those other than milk, and feeding under special conditions. Dr. Lewis discusses the problem of feeding of patients before and after operation, the nutritive value of fluids, what to do in exceptional surgical problems, and the like. The text, though extensive, is well organized. It is divided into three major sections and these into twenty-nine chapters including a comprehensive appendix and index. Section one discusses the problems of nutrition in health and furnishes extensive data on the matter of food utilization and requirement. Section two analyzes the problems of nutrition in relation to disease and introduces a detailed survey of what constitutes the most scientific choice of foods and the nutritional regulation in the so-called deficiency diseases, in diabetes, gout, obesity and leanness, kidney and urinary affections, digestive disorders, and the like. As already hinted, this volume is so comprehensive in its scientific survey of the problem of nutrition that it veritably assumes encyclopedic proportion in this special field. The work is highly recommended.

PNEUMOCONIOSIS (SILICOSIS). THE STORY OF DUSTY LUNGS. A PRELIMINARY REPORT. By *Lewis Gregory Cole*, M.D., Director of Silicotic Research John B. Pierce Foundation, New York City, and *William Gregory Cole*, M.D., New York. Cloth. Pp. 100. Price \$1.00. New York: John B. Pierce Foundation, 1940.

The authors, father and son, who have been interested in the subject of this report undertook a comprehensive study of the nature and disabilities caused by the inhalation of dust and obtained the collaboration of a number of prominent physicians. The text proper is divided into five chapters, the first of which presents a brief account of the means used in the research and the division of labor. The second chapter describes at some detail the dust flecks and their carriers. This is followed by a chapter devoted to a description of four types of pneumoconiosis. The remaining two chapters treat of the roentgenologic and social-economic aspects of this affection. Appended to the report proper are two reprints, one from "Radiology" dealing with the roentgenologic diagnosis, which is well illustrated, and the other from the Journal of the American Medical Association (September 23, 1939, issue) dealing with dyspnea of silicosis. While the subject is discussed in a strictly technical sense, the report proper is rather popular in style and makes pleasing reading. The book which is printed and bound in *de luxe* concludes with an index both to the report and the two reprints. The authors are to be highly commended for the completion of a study whose importance looms greater with the increasing reports. Their work will be accorded the recognition of pioneers in the field and hence deserves warm approval and recommendation.

COMMUNITY HEALTH ORGANIZATION. A MANUAL OF ADMINISTRATION AND PROCEDURE PRIMARILY FOR URBAN AREAS. Edited by *Ira P. Hiscock*, Professor of Public Health, Yale University School of Medicine. Third Edition. Cloth. Price, \$2.50. Pp. 318. New York: The Commonwealth Fund, 1939.

The basis of satisfactory public health work in any community is a well organized health department, adequately financed and staffed with trained personnel. The suggested health organization presented in this volume contains the best plans for organizing a health department in any community which may be modified when necessary to meet local problems, possibilities and future policies. In this third edition most of the chapters have been rewritten and much new material has been added. This has long been a standard health administration handbook. It can be highly recommended to health officers, public health nurses and teachers of public health.

INTERNATIONAL ABSTRACTS

Electric-Convulsion Therapy in Schizophrenia.

Lothar Kalinowsky.

Lancet 2:1232 (Dec. 9) 1939.

The author wishes to draw attention to the method of electric-convulsion therapy in schizophrenia. Cerletti, of Rome, who studied problems in epilepsy by provoking epileptic fits in animals, suggested using the electric current for convulsion therapy, and Bini of Cerletti's clinic constructed a suitable apparatus. To date, several thousand fits have been produced on some hundred patients, partly in the Rome clinic and partly in other institutions, without any accident whatever. The technique of electric-convulsion therapy with Bini's apparatus guarantees that the current passes through the head only. Electrodes, about 4 inches square, are covered with a cloth soaked in conducting fluid (a 20 per cent solution of salt water) and applied to the patient's temples. The area of contact is moistened with the conducting paste used in electrocardiography. The hood with the electrodes is adjusted and the resistance of the head measured with a trial current of 1 milliampere. The potentiometer tension regulator has a graduated revolving drum from which resistance in ohms can be read. This reading, usually 400-1000 volts, determines the voltage to be applied. The switch is changed from the trial to the shock circuit, the voltmeter adjusted, the automatic stopwatch set to 1/10 sec., and the shock circuit closed. A milliammeter shows the amount of current passing during the shock. The first attempt is made with a minimal voltage, generally 60-70 volts. This often is not sufficient to produce a fit, only unconsciousness (petit mal). Therefore the current is reapplied when the patient has regained consciousness, but resistance must again be measured. This is always lower at the second attempt. Convulsive threshold varies considerably from person to person. Usually the author needs currents of 70-110 volts and 300-600 milliamperes. Shocks are produced twice a week. The length of treatment differs in different clinics, but patients who do not improve after 5-10 shocks seldom do so later. The attack corresponds on the whole with the cardiazol convulsion, except in its latent period. On closure of the circuit the patient loses consciousness and is almost immediately seized with generalized tonic contraction. In rarer cases, the muscular contraction may set in $\frac{1}{2}$ min. after loss of consciousness, but the patient is unaware of any latent period. After the attack he awakens slowly and regains consciousness after a few minutes, is able to speak although somewhat drowsy. After 8-10 min. he seems completely normal, and if put to bed he sleeps quietly for a few hours, awaking quite restored. The advantages of the method include absence of disagreeable subjective

sensations, of psychomotor agitation, and economy. The author has not seen any fractures, dislocations or ruptured muscles, but is not prepared to say that they can not happen. Perhaps the absence of such complications is due to the fact that the fit does not develop in a state of motor agitation as in cardiazol attacks, in which the patient often fights with the nurses and has his muscles strongly contracted when the violent fit sets in. The effects on the brain are not yet completely elucidated. Accornero is now working on histologic changes after electric shock. In a personal communication he states that even with much higher voltage than used in man, animals show only unimportant and reversible changes. The number of cases so far treated is too restricted to permit of definite conclusions as to the effectiveness of the method, but from the material available it compares favorably with cardiazol therapy in the same clinics.

Circulatory Function in the Anemias of Children.

F. Howell Wright.

Am. J. Dis. Child. 57:15 (Jan.) 1939.

One of the remarkable features about children suffering from severe but chronic forms of anemia is the absence of apparent restriction of their ability to take exercise. Wright has repeatedly noticed that children with a red blood cell count of 2,000,000 or less may play with all the vigor of their healthy brothers and sisters and yet fail to display dyspnea or other symptoms of embarrassment. It would appear that in some way these patients succeed in becoming adapted to their abnormal internal environment. Clinical observations agree with the view that it is a feeling of lassitude and of weakness of the limbs, rather than shortness of breath, which eventually limits activity. This suggests that, as in normal subjects, it is the skeletal muscle rather than the myocardium which first fails to respond to an increased amount of work, whereas the earliest symptom of most varieties of cardiac dysfunction is respiratory difficulty rather than fatigue of the voluntary muscles.

Study of exercise tolerance in anemic children confirms these general impressions. Figures obtained during the tests, especially those related to blood pressures, show so much variation as to make interpretation difficult. Similar fluctuations during and after the third minute following exercise were seen among the normal control subjects as well, hence an exercise tolerance test has its limitations when employed in the examination of children. There is a distinct contrast between the responses of the patient with acute and of those with chronic anemia. The former shows an impairment of tolerance which is much greater than that of the latter patients. Such a difference in

behavior might be expected, since those with chronic anemia had a long time in which to adapt themselves to the deficiencies of their blood supplies, while such a compensatory period was lacking for the child in whom the onset of anemia was acute. On the other hand, the relatively normal results of exercise tolerance tests of the children with chronic anemia were astonishing in view of signs of cardiac damage. The exercise tolerance test in this case was not performed until all evidence of failure had disappeared after a period of rest in bed. Since according to the exercise tolerance test the capacity of the patients with chronic anemia was little diminished, it is apparent that the usual criteria of change in pulse rate, blood pressure and respiratory rate cannot be used for measuring either the severity of the cardiac lesion resulting from anemia or the effect of transfusion on the heart.

Electric Stimulation and the Excitatory Process in the Nerve Fiber. Ichiji Tasaki.

Am. J. Physiol. **125**:380 (Feb. 1) 1939.

The mechanism of electric excitation of the nerve fiber has been investigated by the method of tripolar stimulation. The plasma membrane at the node of Ranvier (coaxial with the axis) is the place where Nernst's polarization occurs. The resistance through this membrane is inferred to be of the order of ten megohms as measured with the stimulating current. The myelin sheath must be regarded as a practically perfect electric insulator. The excitatory state (or disturbance) is produced by the outward-directed potential-drop across the plasma membrane at the node. The "law of proportionality and superposition" applies to this state. When a potential difference is applied to a nerve fiber between two neighboring nodes of Ranvier, excitatory states are produced all along the fiber. Spread of the stimulating current in the nerve trunk is explained upon a physical structural basis. The strength-duration curve varies with the distribution of potential along the nerve fiber. Variability of the resistance through the plasma membrane accounts for this fact. The dependence of the chronaxia upon the size of the electrode and its allied phenomena is explained from this standpoint.

Late Results in Retinal Detachment Operations. Dohrmann K. Pischel.

Am. J. Ophth. **22**:130 (Feb.) 1939.

Of 63 patients who had been operated upon at least a year previously, 37, or 58 per cent, had a successful issue. Of these 37 successful cases, only 32 could be found for reexamination. All cases had been operated upon by the Safar method of multiple diathermy puncture. While in the earliest cases only one line of pins had been inserted, in all the later cases double rows of pins had been used, together with transcleral treatment (Larsson) or with bident electrode. There were four cases of more than four years', five of more than three years', six of more than two years', and eighteen of more than one year's

standing. No relapse had occurred in any case which was "cured" for three months.

Four patients "cured" had a recurrence within three months of the first operation, but were permanently cured by a second operation, while a fifth had two recurrences within the same period of time and was cured by a third operation. Only one case of cataract developed in previously uninjured lenses. Three cases of traumatic complicated cataract showed an increase in density of the lens opacity, as did one of complicated cataract. All vision once regained was successfully retained except in three cases of cataract.

Irradiation of Carotid Sinus in Hypertension.

A. Delachaux and G. Schneider.

Schweiz. med. Wochenschr. **69**:522 (June 10) 1939.

On the basis of their observations, the authors conclude that the treatment of hypertension by irradiation of the carotid sinus with short waves can be used for ambulatory treatment. They give three treatments a week for a period of from two to three weeks. They obtained improvement in fifteen of their thirty-three cases when the usual medicinal methods had failed. The best results were obtained in the patients with arteriosclerosis and essential arterial hypertension. In generalized arteriosclerosis and hypertension, however, the results were less frequent and less clear. Finally, the patients with chronic nephritis reacted only slightly to the irradiation. In essential hypertension and in arteriosclerosis the patients experience a sensation of well-being at the same time that a greater or lesser decrease takes place in their arterial tension, whereas the patients with chronic nephritis and often also those with generalized arteriosclerosis have disagreeable sensations and slight fluctuations in blood pressure. The method is contraindicated in chronic nephritis, asystole and thyroid disturbances. If generalized arteriosclerosis is accompanied by hypertension the short wave treatment of the carotid sinus can be tried, but if the reactions after the first irradiations are disagreeable it should be discontinued. — [J. A. M. A. **113**:726 (Aug. 19) 1939.]

Short Wave Therapy in the Treatment of Asthma.

J. P. P. Stock.

Brit. J. Phys. Med. **2**:32 (Feb.) 1939.

The value of short wave therapy has become increasingly apparent as the technic was gradually improved. The action of the short wave current on an infected nasal mucosa has formed the subject of careful study from the clinical and pathological standpoint. A full account of the findings will be published at a later date, but it is necessary to point out here that its action is not the same as that of argyrol. It is tentatively suggested that their respective actions may be conveniently described as follows: Argyrol causes deturgescence of a mucosa in which the mucous glands are distended with secretion. The resulting subsidence of swelling restores drainage where this has been stagnant.

Short wave therapy has a different action which appears at least to be three-fold: (1) It inhibits the activity of bacteria. (2) It stimulates the body's defensive processes, and (3) it quickly causes shrinkage of a swelled mucosa, particularly if this swelling is allergic in origin. Here its action differs from that of argyrol. If the mucosa is "choked" with mucus, short wave therapy is of little help and argyrol must first be used. This difference in action appeared to explain why the combination of the ethmoid pack and short wave therapy gave much more satisfactory results than either treatment alone. Their actions would seem to be complementary.

Otitis and Sinusitis in the Swimmer. H. Marshall Taylor.

J. A. M. A. 113:892 (Sept. 2) 1939.

The observations were made on eight subjects who swam for forty-five minutes in ocean water at a temperature of 68.5 F. Immediately before and after this period the weight, temperature, blood pressure and blood count of each participant were ascertained. After the swim they all exhibited a diffuse generalized purplish hue and their lips and nail beds were moderately cyanotic. There was an average reduction of 4 F. in the rectal temperature. The erythrocyte count was increased by from 700,000 to 1,500,000 and in the leukocyte count there was a consistent increase of from 8,000 to 10,000. The differential count indicated a normal Schilling index. Both the systolic and the diastolic blood pressure were increased, the diastolic pressure having the greater average rise, which was from twenty to thirty points. These observations led to the conclusion that prolonged chilling produces peripheral vasoconstriction, peripheral stasis and anoxemia.

It is now an accepted fact that chilling of the body surfaces causes constriction of the blood vessels of the skin and periphery, followed by a constriction of the blood vessels of the nasal mucous membrane. Also, it is generally acknowledged that prolonged ischemia of the nasal mucous membrane naturally reduces the local resistance and favors infection.

Recent studies by Dyrenforth and the author showed that chilling of the body surfaces without concomitant exercise produces leukopenia, with cells of the polymorphonuclear neutrophilic type. The application of this observation is that the child or adult, particularly when frequenting the indoor swimming pool, where the body is not exposed to the warm rays of the sun, should be constantly active instead of following the common practice of sitting around on a cold tile floor in a cold wet bathing suit. This popular custom is as conducive to cold as wrapping oneself in a wet blanket and sitting on a concrete floor of a basement. The bather who is inactive on a windy beach, where there is a rapid loss of body heat from evaporation invites the same risk.

Galvanic Reaction in Guinea Pigs. A. R. Buchanan, and Laura D. Ladd.

Arch. Otol. 29:124 (Jan.) 1939.

The reaction of guinea pigs to the galvanic current with one electrode applied to the tragus and the other to the dorsum of the neck has been studied. An apparatus has been devised by which the reactions may be recorded on a kymograph. The records obtained from a series of 30 animals indicate that the reaction has a definite direction in relation to the polarity of the electrode in contact with the ear. Uniformity in the force and direction of the reaction has been facilitated by local anesthesia of the skin at the points of application of the electrodes, which eliminates the factor of pain. There is an apparent variation from animal to animal in sensitivity to the flow of the galvanic current; this has been found also in human beings.

The direction of the reaction follows the classic descriptions, being always toward the anode and away from the cathode. With the currents used (2 to 5 milliamperes) neither anodal nor cathodal stimulation has proved more effective. The strength of the reaction, however, can be influenced by increasing the amount of current, more forcible reactions being obtained when larger amounts of current are used. Galvanic nystagmus directed away from the anode was present, but was not studied, interest being confined to an attempt to duplicate the galvanic falling reaction described and used clinically by Blonder.

Skin Reactions. Treatment of Hay Fever Coseasonally by Electrophoresis of Active Constituent of Ragweed Extract — Preliminary Report. Harold A. Abramson.

New York State J. Med. 39:1611 (Aug.) 1939.

It has been previously reported that comparatively large quantities of the biologically active substances present in ragweed and timothy extracts may be transported into the living human skin by electrophoresis.

Throughout the past year the author successfully utilized the electrophoretic method in skin-testing the individuals hypersensitivity to ragweed and to timothy. The method is sufficiently sensitive to yield positive reactions with solutions containing as little as 0.0001 mg. of protein nitrogen per cc. in individuals with sufficiently sensitive skins. During the past ragweed season it was thought desirable to attempt coseasonal therapy with ragweed extract in a logical attempt to extend the observation that the ragweed could be introduced into the skin with ease.

The electrophoretic method not only administers small quantities of ragweed intradermally, but also permits different quantities to be administered by varying the three parameters: (1) electrode area; (2) current; and (3) concentration of solution. The procedure adopted was as follows: The same solution was used throughout the summer. This solution was a specially prepared dialyzed extract of giant ragweed, contain-

ing 0.07 mg. of total nitrogen (protein) per cc. A piece of cotton 1 or more square cm. in area, depending upon the case, was moistened with the solution, and the current applied for two to five minutes.

Arthritis: Treatment by Hyperpyrexia. Hal M. Davison; Mason I. Lowance, and Wm. R. Crowe.

J. M. A. Georgia 28:245 (June) 1939.

An analysis of 264 cases of arthritis of various types treated by hyperpyrexia are here presented. Treatment was conducted by means of a cabinet type of machine, and these were given in the office. Treatments were of short duration, varying from one hour to 5 hours, with temperature varying from 101 (oral) to 105.5 F. (oral) in the atrophic and hypertrophic types, and from 105 (oral) to 106.5 F. in the cases of gonococcal arthritis. The results obtained show that (a) hyperpyrexia is useful in the treatment of both atrophic and hypertrophic arthritis as well as in the treatment of the gonococcal type, (b) that the procedure can be made safe in the treatment of hypertrophic arthritis, and (c) that further observation on this method of treatment should be made before it is discarded as a therapeutic procedure for atrophic and hypertrophic arthritis.

Severe Cutaneous and General Reaction Following Administration of M & B 693 (Sulfanilamide) and Exposure to Ultraviolet Light. Rupert Hallam.

Brit. M. J. 1:559 (Mar. 18) 1939.

A severe reaction may follow exposure to light during or following administration of the sulfanilamide group of drugs. Rimington and Hemmings demonstrated that sulfanilamide causes an increased secretion of porphyrin in the urine, of which coproporphyrin I is an active photosensitizer. Hallam reports a case of a man who received a small dose of M & B 693, followed by a moderate dose of ultraviolet light. A severe reaction occurred, which was probably due to the fact that this man's skin was photosensitized by some chemical reaction following the use of the drug. Every prescriber of M & B 693 should be aware of this danger, and every patient should be warned against exposure to strong sunlight or any form of artificial sunlight while taking this drug.

Physiotherapy in the Common Cold and Sinusitis.
W. Kerr Russell.

Brit. J. Phys. Med. 2:92 (April) 1939.

Treatment for the common cold can be general and local. General treatment includes sweating baths, such as turkish, foam, mustard, steam baths or a mild pyrexia treatment. Ultrashort wave therapy is the most valuable form of local treatment. If a cold is treated early during the congestive stage, one application of ultrashort waves generally effects a cure. Treatment is best given with a valve apparatus, using a 6-meter wavelength and 10 cm. glass Schliephake electrodes. With the patient seated, one electrode is placed over the lower part of the neck and the other over the front of the nose. The metal plate in the posterior electrode is placed farther from the body than the anterior one, 2½ cm. being usual. Treatment is given for 10 to 15 minutes, and a second treatment within 24 hours is advisable. If short wave treatment is not available, infra-red rays or radiant heat may be used.

Ultrashort wave therapy is the most valuable method of dealing with sinusitis. When free drainage is present, the treatments are soothing from the start, and pain is relieved. If, however, there is enclosed pus with no outlet, the first few treatments may be followed by increased pain. The discharge may increase in amount and become sanguineous, and may persist for six or seven applications before it subsides. Transient vertigo may accompany initial treatments, but this can be avoided by keeping the patient at rest for a short period after the treatment. Marked relief may follow 10 to 12 applications, which may be given daily or on alternate days; in chronic cases, as many as 36 applications may be necessary. Treatment is given with a tube apparatus, using the 6-meter wavelength and air-spaced electrodes. It is applied anteroposteriorly, the anterior electrode being placed over the frontal sinuses when these or the ethmoidal and sphenoidal cells are affected, and the posterior electrode is placed over the nape of the neck. If the antra are affected, the patient lies in a chair with his back to the apparatus, and the electrodes are placed obliquely over each cheek. Initial treatments are five minutes, and are subsequently increased to 10 minutes.

